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WOODSIDE BURNSIDE HILLSIDE AND MARSH

BY

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WITH NUMEROUS ILLUSTRATIONS

London
SWAN SONNENSCHEIN & CO
PATERNOSTER SQUARE
1894

Butler & Tanner,
The Selwood Printing Works,
Frome, and London.

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PREFACE

THE favourable reception which has been accorded to *Random Recollections of Woodland, Fen and Hill*, has encouraged me to prepare another series of similar sketches. In this volume, as in that just referred to, my aim has been to bring under the notice of the general public, in readable and untechnical language, a few of the interesting phenomena which are to be observed everywhere around us by those who take the trouble to look for them, and to give such explanations of their causes as may easily be understood even by those whose scientific knowledge is small.

In selecting localities, I have chosen for three of the chapters what are now historical spots. "Woodside" describes a ramble from Rochester to Cobham, with a visit to the famous inn to which Mr. Tupman retired after being jilted by Miss Wardle, the return being through Cobham Park, a walk which it will be remembered was a favourite with Mr. Pickwick and the Pickwickians. "Hillside" describes part of that famous ground over which Mr. Winkle and Mr. Tupman are said to have displayed their remarkable sporting abilities; whilst "Marsh" introduces the reader to those "meshes" over which Little Pip so frequently gazed to the river (where lay the hulks from which the convict escaped), and which the latter had to cross before his memorable meeting with Little Pip in Cooling churchyard.

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BY THE SAME AUTHOR

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WOODSIDE.

ALL is calm and peaceful. The tranquil air scarcely raising a rustle in the elms above my head or a ripple on the surface of the pond at my feet; the fragrance of sweet-scented flowers diffused from the garden just behind me, and from the newly mown hay in the field at my side; the sun brilliant in the deep blue sky, across which an occasional cumulus cloud of varying but fantastic shape slowly sails along far up in the air, whilst here and there stationary lines of fleecy vapour rise high near the zenith; the warbling of the lark as he sings his matin hymn, mounting higher and higher as he pours out his soul in ecstasy, until lost to sight and sound; all these combine to give me a feeling of perfect rest and contentment, as I lie at full length in the newly mown grass of a meadow, with my feet dangling over the edge of a still pool in whose placid waters the beautiful tints of the elms above me are reflected.

The meadow is situated just where the roads from Cobham and Gravesend meet and unite to form a single road, which leads into and through Rochester, the venerable city that I can see at the bottom of the hill. This road down the hill is hewn out of the chalk; its sides are rough and steep, but almost covered with wild rose-bushes, which maintain a precarious position in the clefts and crannies of

the broken chalk, whilst the bushes which form a narrow margin along the edge are festooned with the slender climbing stems of the Clematis or Traveller's Joy. Just behind me the hill is capped with clays and sands of newer age than the chalk, and on these stretch for many miles the far-famed Cobham woods, broken here and there by villages and outlying farms.

It is a perfect morning in the early days of leafy June. A faint smoky haze still hangs over the busy city, and its still busier neighbour, Strood, in front of me. Between the two a silver streak may be seen, which is the river Medway flowing placidly down to the sea. As I rise and turn my back on this view, I face the two roads in front of me uncertain which to choose for a stroll. The one to Gravesend is broad and well kept, but dusty from the abundance of traffic ; the other, which leads to Cobham, is narrow and rough, with deep ruts and muddy places, but is overhung now and again with tall hedges and trees, here passing through trim parks, there through lordly woods, its banks strewn with wild flowers galore. My mind, however, is soon made up ; we will, dear reader, take the road to Cobham.

We shall miss Gad's Hill, the last residence of Charles Dickens, but we shall see a favourite spot of his, the far-famed inn in Cobham. I often saw him, some twenty-five or thirty years ago, as he passed through the single, long, rambling street of Strood to the old city which he has made so familiar to the world.

The pasture-fields are studded with buttercups, twin favourite with daisies of little children, and a near relation of that brilliant little flower that charms us—

"Ere a leaf is on the bush,
In the time before the thrush
Has a thought about its nest,"

and which the poet tell us comes—

"With half a call,
Spreading out thy glossy breast
Like a careless prodigal,
Telling tales about the sun
When we've little warmth or none."

Glossy indeed are the brilliant petals of the Lesser Celandine (Fig. 1), although the buttercup by its profusion makes a much more effective show.

Soon we are between deep-cut banks with broad thick hedge-rows and miniature coppices, thickly studded with thorn and holly, ash and spindle, whilst bramble and clematis weave a mantle over them in many places, their long trailing branches, which hang down from the higher bushes, making a drapery of exquisite loveliness. From the thick-set bushes the thrush and greenfinch steal quietly away; the blackbird, with its loud, frightened clutter, flies off hastily; whilst other denizens of the hedge-row carefully hop some distance through the thick leafy screen before showing themselves, in order to distract the attention of the passer-by from their nests and the treasures they contain.

Soon a rich perfume falls upon our senses—

"Like the sweet south
That breathes upon a bank of violets,
Stealing and giving odour."

It appears to come from a narrow belt of ground lying by the side of the road, and a few moments' search reveals a bed of sweet-scented violets. These appear to be rather remarkable, for the greater number of these richly scented flowers

are of a much redder tint than we usually associate with this beautiful flower. There, though, is a plant with white flowers, and there is another with flowers of the ordinary

Fig. 1.—Lesser Celandine or Pilewort (*Ranunculus ficaria*).

colour; all are equally strongly scented, but the blossoms of the last are rather narrower than those of the redder kind. As we drink in the perfume, Shakespeare's lines forcibly recur to us, in which he speaks of—

"Violets dim,
But sweeter than the lids of Juno's eyes
Or Cytherea's breath."

No wonder this flower, with its delicious perfume, was named *odorata*, for what can be more odorous than this lovely, modest inhabitant of wayside hedge and mossy woodland bank?

But we must go on, now passing a field of young corn, then a hop garden with the young plants still striving to reach the top of the poles, whilst, behind all, the dark woods form a conspicuous background. Here, to our left, is a narrow shaw, where the birds are raising their voices in melodious homage to spring. A level piece of country follows with low hedges, the young corn in the fields on either side forming a lovely carpet of delicate green. To the right, the undulating ground rolls on and on, yonder rise just shutting out Gad's Hill, where the home of Dickens lies 'mid country sounds and sights.

Now the woods creep slowly up. Nearer and nearer they approach, until at last they edge the left-hand side of the road along which we are passing. What lovely mossy banks! How thickly they are covered with primroses and violets! But, notwithstanding all this profusion of violets, there is no perfume perceptible; all this wealth of blossom appeals only to the eye, the brilliant carpet has nothing to attract our sense of smell.

This is not the same species of violet that we were charmed with just now. It is commonly called *Viola canina*, or the dog violet. But, although it has no scent, the blossom itself is very similar to that of *Viola odorata*, and there are a great many interesting scientific facts which

are common to both. The first of these is the peculiar manner in which the young leaf is folded up on both sides, from the margin to the mid-rib, exemplifying what is known as involute vernation. What a spring-like ring this term has, and how fittingly is it applied to the method in which the leaf is folded in the bud; for spring is, *par excellence*, the time of leaves, just as summer is the time of flowers. Still more important is the method of fertilisation, and the wonderful modification that the petals have undergone to ensure the visits of insects to the flower. The lowest petal of the attractive corolla is, as you see, elongated into the form of a tube or spur, called a nectary, and this is provided with little glands, which distil from the sap the sweet nectar that insects so dearly love. The anthers are arranged in the form of a cylinder, and each one bears a little filament, which juts out into the upper part of the nectary. When an insect flies to the violet and pushes its head into the nectary, in order to drive its tongue deep enough to reach the nectar, its head is forced against these little prolongations, which stand out from the anthers, and this pressure, acting as a lever on them, causes the anthers to bend downward and scatter their pollen on the hairy thorax of the insect. It then goes to another flower, and, in forcing its way to the nectary, rubs some of the pollen, which has already become entangled in its hairs, on the sticky surface of the stigma which projects beyond the stamens (so making self-fertilization impossible), and the pollen thus left fertilizes the flower.

But these are not the only remarkable things about the violet. After the ordinary flowers are over, you may find, low down on the plant, beneath the leaves, tiny blossoms

with well-developed stamens and pistil, but with the calyx small and unopened, and without a corolla. These flowers are exceedingly simple, and are called cleistogamous. You know, of course, that the calyx and corolla are not necessary for the production of seed, and hence their abortion does not count for much. The stamens and pistil, however, are well developed, and arranged so simply that the pollen falls almost directly on the stigma, and ultimately fertilizes the ovules, a very wise provision, seeing that the flowers have no attractive corolla to tempt insects to visit them. It is remarkable, however, that these ill-developed flowers produce more abundant seed than the sweet-scented, and, so far as the floral beauty of the flowers is concerned, more perfectly developed ones.

We will make a *détour* up the lane for a short distance. What is that wealth of white blossom we see? It is not so dense as the masses of summer snow which the hawthorn bears, but the blossoms are larger and quite as beautiful. As we approach it we see that it is that prime woodland favourite, the wild cherry. So delicate do the blossoms appear that it seems as if the slightest breeze would strew the lovely petals on the ground, as indeed it would; but there is no fear of that this morning, and we feel as we gaze in rapt attention that—

> "There was never yet so pretty a thing
> By racing river or bubbling spring,
> Nothing that ever so merrily grew
> Up to the clouds when the skies were blue,
> Nothing so brave, nothing so free,
> As thou, my wild, wild Cherry tree."

Its long pointed leaves, with a delicate crimson blush on them, are also very pretty, and the sight of this wild plant

reminds us of the cultivated cherries in the gardens all around; for are we not in "The Garden of England," the county far famed for "hops, fair maids, cherries and civility"? Our minds run back rapidly; we think of Lucullus, the Roman general, who brought the tree into Europe from Asia, and recall the fact that when introduced into Britain years afterwards, first the monks, and afterwards our royal sovereigns, deigned to grow this delicious fruit, both for pleasure and profit, and gave to Kent its position, *par excellence*, as a cherry-growing county.

We come out into the road again a little higher up, near some cottages, and close to a road which leads to Gad's Hill; then on past the inn, where we find the ground cleared again on both sides, although wooded knolls appear on the topmost ridges. Soon, on the left-hand side of the road, the woods creep down again, and grand old oaks spread their massive branches over the road, whilst a thick undergrowth of hazel, sallow, blackthorn and whitethorn forms a dense covering which bids defiance to him who would enter from the road, and affords a safe retreat to multitudes of birds. Here and there an old trunk is almost hidden with a wonderful covering of ivy, reminding us that Shakespeare makes one of his characters say—

> "The ivy which had hid my princely trunk,
> And sucked my verdure out."

Although, rather than as an emblem of false friendship, we would prefer to look on it as "striving to hide time's envious ravages," and as lending—

> "Beauty to decay and death,
> Throwing a loveliness round loveless things."

From the trees hundreds of tiny spiders are hanging their

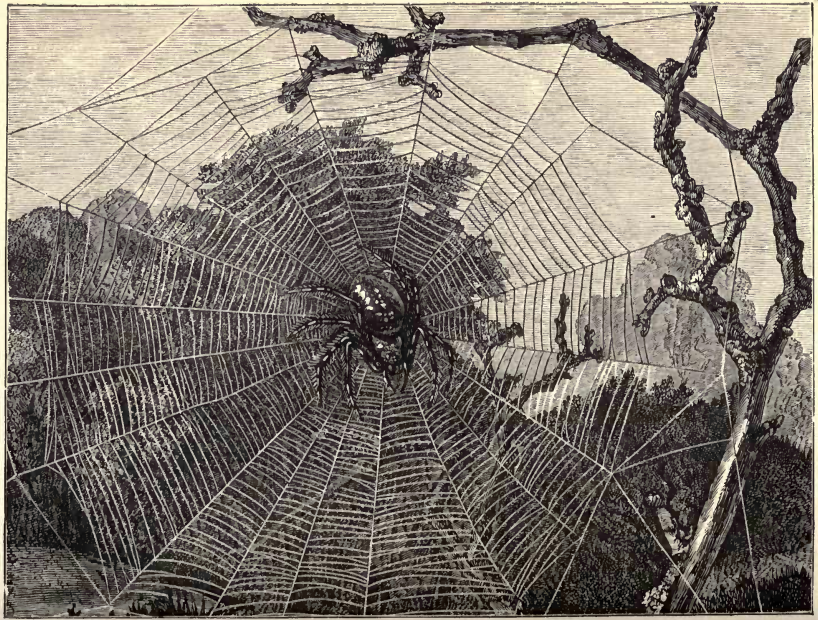


FIG. 2.—ORBIT-WEAVING SPIDER AND ITS WEB.

fleecy, filmy webs, floating in the air, collecting on our clothes, and frequently coming against our faces. "Aërial" spiders they are generally called, and they well deserve the name.

What a charming variety there is in the appearance and habits of our British spiders. One bores a hole deep into a bank, lines the cavity with silk, and spreads its web over the surface of the ground and low plants near; another builds a kind of diving-bell tube in the water; a third spins its extensive web from bush to bush, or from tree to tree; in short, each species has its own peculiar habits, and its own peculiar methods for attracting and capturing its prey.

We still notice under these trees the fine, gossamer-like webs floating in every direction, too long for us to see to what they are attached or where they end. "Gossamer spiders" is another name given to the aërial spinners of these delicate floating threads, but they are simply the young of many different species, belonging, in fact, to many different families. Large numbers of spiders' eggs hatch in the spring, and Nature at once teaches the young ones to rove, to travel far and wide out of reach of each other, so as not to interfere with one another in their search for food. Thus, acting under the guidance of the Great Mother, we sometimes see, as here, every branch, every twig of a tree, maybe every stem of grass, with its tiny occupant giving out these light, aërial filaments. As they spin, an air current draws what is at first a comparatively short thread farther and farther; and the spider, owing to the thread not catching on anything and so becoming fixed, goes on spinning, in order to keep up the continuity, until an exceedingly long thread is formed. Presently this catches on some obstacle, and away the little

fellow floats, climbing along the thread, buoyed up by its silken line. On some fine mornings whole crowds are to be seen thus floating in the air, and so numerous are the trailing lines that they unite and fall so thickly as to be quite conspicuous, although the resemblance to a slight snow-shower, which has more than once been suggested, is very far-fetched.

The country people look upon these aërial spiders as a kind of weather indicator, and conclude that, so long as the threads continue to fly high in the air, a continuation of fine weather may be safely anticipated, but that, when they shimmer like sparkling silver near the ground, bad weather may safely be prognosticated.

Is the spider an insect? Certainly not, although it is frequently spoken of as such by those who really know better. How, then, does it differ from an insect? Well, first of all, a spider has eight legs, an insect never more than six, although the caterpillars of butterflies and moths have a number of false legs, or pro-legs, on which they walk, and which are frequently mistaken for true legs. The head and thorax of spiders, too, are united into one piece, whilst those of insects are jointed to each other. But what is still more important is that the spider undergoes no real metamorphosis. When a spider emerges from an egg, it is exactly like its parent—once a spider always a spider, as it were. An insect, on the other hand, undergoes a certain number of changes, and appears under various guises in the course of its life. The butterfly's egg becomes a caterpillar, and this a chrysalis, before finally the butterfly itself appears.

How does a spider spin its web? Let us find one, and watch the process. At the end of its body is a gland which

secretes a sticky fluid; from this gland grow six tiny projections, which are provided with minute tubes, called spinnerets (Fig. 3), and down these tubes the viscid fluid passes; through the extremities of the spinnerets the fluid is expressed, solidifying immediately it is exposed to the atmosphere, and forming a silken thread; the thread thus formed is built up into the webs in a great variety of patterns.

The various patterns adopted by spiders in their web-

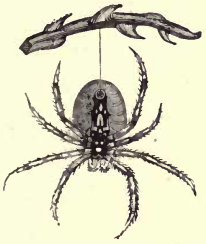


Fig. 3.—Spinnerets of Spider.

spinning are very important, because naturalists have grouped spiders into four classes on this character alone. Here is a spider's net spun in the form of a round ring or orbit, with straight lines of thread radiating from the centre to the outer ring, whilst other rings, getting smaller and smaller as they approach the centre, are spun parallel with the outside ring (Fig. 2). These are called *Orbitelariæ*, from this simple fact. There is another web suspended on this bush, with threads crossing and recrossing each other like a net, and hence the Latin word "rete," which means "a net," gives us the class called *Retitelariæ*.

Here is a hole in the wall, which a spider has selected for its home. It has lined it with silk and formed a tube, so that you will not be surprised to hear that this spider belongs to the *Tubitelariæ*; whilst on the bank another kind has not made use of a hole ready prepared for it, but has actually bored a hole in the ground before building its tube. Those that bore into the ground are called *Territelariæ*. The names are well chosen, and you can remember the four groups of spiders as (1) the "orbit weavers," (2) the "net weavers," (3) the "tube spinners," and (4) the "earth borers."

How well does the poet describe the "orbit weaver's" work :—

> "Still at the centre she her warp begins,
> Then round at length her little thread she spins,
> And equal distance to her compass leaves;
> Then neat and nimbly her new web she weaves,
> With her fine shuttle circularly drawn
> Through all the circuit of her open lawn.
> Open! lest else the ungentle wind should tear
> Her cypress tent, weaker than any hair;
> And then the foolish fly might easier get
> Within the meshes of the curious net,
> Which he no sooner doth begin to shake,
> But straight the male doth to the centre make,
> That he may conquer more securely there
> The humming creature hampered in his snare."

You would like to know something about the way in which the spider digests its food. This is exceedingly simple. Since the spider lives on the juices of the various animals on which it preys, very little digestion is necessary. Its mouth leads through a short gullet into a very simple stomach, which narrows again into a rather short, coiled

intestine. As might be expected, we find that those animals which live on very soluble and easily-digested material have short alimentary canals, whilst those which live on harder and more indigestible material have longer ones. Nature throws away no chance of getting the greatest amount of nutritive material from the food, whilst at the same time she does no unnecessary work. The method of digestion carried on in the spider follows out this rule, and is almost exactly identical with that of a butterfly or moth, its circulation and respiration being also very similar.

The eyes of spiders, however, are very different from those of most insects. In the caterpillar of a butterfly there are six pairs of eyes, six eyes being placed on each side of the cheek in lunular form, and each eye consists of a simple convex lens. When the caterpillar has become a butterfly the eyes are very different. Now there is one large eye on each side, compound in structure, convex in shape, made up of some thousands of hexagonal facets crowded together. The spider never has compound eyes; the number varies in the different species, although usually there are eight. These are simple and immovable, but as the eyes are spread over a considerable area, and the visual axes lie in various directions, the spider is able to get almost as wide a field of vision as if it could turn its head or move its eyes. Sometimes the eyes are arranged in two, sometimes in three rows, and this arrangement is very important to the scientific naturalist.

Under the microscope the eyes of butterflies and moths attract us by the remarkable minuteness and excessive number of the facets into which they are divided. The eyes of spiders have no such minute divisions, but those of

some are very beautiful, nevertheless, in their varying lustre of opal and green reflections. "Diurnal eyes," a celebrated French naturalist called these lovely organs, but it appears to be a somewhat fanciful appellation. There are many other interesting things about spiders' eyes, not the least of which are the wonderful excrescences upon which they are sometimes borne.

Here, on this piece of old fence, you will observe that in almost every protected nook and cranny a female spider has laid her eggs. How well she protected and covered them with silk when she laid them! These webs are mostly empty; the little aërial spiders we noticed just now have escaped from some of them. Here is a rolled-up leaf on the bank, carefully sewn together! As you pick it, a spider runs out from one end of the tube, and when you open it you find within a little mass of pale, flesh-coloured eggs, protected by a silken covering. We have disturbed her in her work; but one cannot help admiring the instinct which teaches her thus to protect her helpless eggs.

We have lingered some time over the spiders, but now we will step out again. To the right, a footpath across the fields leads past wooded knolls and leafy coppices to Shorne. To the left the wood is dense, and the trees in many places entirely overshadow the road. Presently we come to a fence, which runs through the wood at right angles to the road, and here the undergrowth disappears. Across gentle undulating sweeps, dotted, here thickly, there more sparingly, with massive oaks and gnarled hawthorns, with sweeping chestnuts and majestic ash trees, the whole backed by thick dense woods, we get our first view of Cobham Park. Yonder is a herd of deer, half hidden amongst the old

bracken, whilst, as we rapidly leave the "Pale" (as the fence separating the park from the wood is called) behind, the trees become fewer and the views more extensive.

We have come to a standstill by some steps that lead into the park, and now, slowly climbing them, we stand within it; and I think there is a pond close by. Yes, here is the old pond, and there, overhanging one end of it, is the old hawthorn tree into which I have frequently climbed for mistletoe; and, yes! there are still some little shoots of mistletoe growing from its branches.

Let us stay a while and investigate this pond. In spring and early summer can anything be more interesting than to watch the inhabitants of some large roadside pond, shaded by tall trees? The diver water-beetle, using his beautifully fringed hind legs as oars, propels himself skilfully and rapidly along; the water-spider, in its diving-bell apparatus; frogs, toads, and newts; all these may be studied there, whilst water weeds of different shades and hues afford endless variety and interest.

See! There is a newt, his crimson-tipped crests contrasting strongly with the brilliant green of the pond-weed, among which he cunningly and dexterously steers himself. In the very early days of spring he does not possess these crimson adornments: they grow as the weather gets warm and the breeding season draws near, and then the "warty" newt becomes quite a handsome fellow. In May his back becomes brownish-green, whilst his belly is bright reddish-orange, and the sides of the gentleman's tail are of a clear pearly-white hue. The male, too, has a jagged crest running down the back, and the sharp points of this become, at this time of the year, tipped with bright crimson. But do you

notice, swimming towards us, a prettily-spotted newt without the brilliant colours? That is the lady newt, and she is evidently busy searching for suitable places in which to lay her eggs. Watch her as she chooses the long leaf of some water plant, or the broad leaf of a piece of grass near the edge, and fastens to it a roundish egg by means of the sticky gelatinous matter with which it is covered. Yes; there is the egg! But what is she doing now? She is carefully rolling up the leaf, on which the egg is deposited, until the latter is quite shut in, and then you see she gums the edges of the leaf together, and is off to lay another. What a wonderful provision of nature is this which enables the newt thus to protect and preserve her eggs from the many hungry creatures that abound in our ponds.

But the newt does not lay all her eggs at once. It takes a considerable time for her to complete the process, and hence, if we search keenly, we may probably find some young newts already hatched. Yes, here they are! Those tiny, black, tadpole-looking objects young newts? Certainly. The yolk of the newt's egg divides and sub-divides into a multitude of cells; from these the young one is built up, and when the egg hatches, this tiny little tadpole-looking creature is the result. It is very much like the young of the frog, and lives under water like a fish, breathing by means of gills.

I have not time to-day to tell you all about the respiratory apparatus, and the changes which it undergoes when the newt-tadpole becomes a newt. Very likely, in the course of our rambles together, we shall come across a toad, which very much resembles the newt in this respect, and we can go into the matter then.

FIG. 4.—GROUP OF NEWTS.

Whilst the changes in the method of breathing are going on, a pair of fore-legs grow out from the shoulders, followed by a pair of hind-legs from the back part of the body, and then we have a perfect little newt. Now our little fish-like animal can leave the water and come out on the land; it can crawl about with its newly-formed legs and breathe in

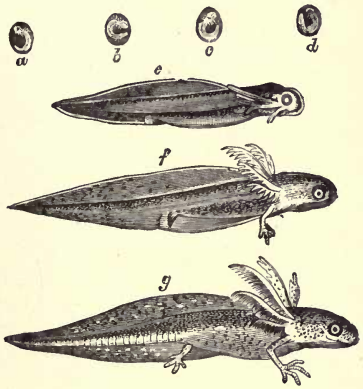


FIG. 5.—METAMORPHOSIS OF NEWT.

a, *b*, *c*, *d*, Various stages in development of egg.
e, *f*, *g*, Progressive stages in development of immature newt.

the air in the same way that the higher animals do, by means of its lungs. Turn that large stone over at your feet. See, there is a young newt which has quite given up its watery habits; it has forsaken the manner of life and habits of a fish, and adopted those of a reptile.

But the full-grown newt also leaves the water when its

parental obligations have been fulfilled, and egg-laying is finished It exchanges its food of water-bugs and water-beetles for slugs, worms and insects, and is thus of great service to the farmer, In Kent, however, the ignorant labourers make it responsible for a variety of dreadful actions—poisoning being one of the commonest charges brought against these harmless creatures. Snakes are among their greatest enemies, and consider them a great delicacy. The newts themselves are not fastidious in their taste, but in the water the tables are frequently turned on the newt; for, although small beetles are its legitimate quarry, a newt may occasionally be seen in the ferocious and merciless clutches of that dreadful scourge of our ponds and ditches, the diverbeetle, who, fixing its jaws deep into the fleshy parts of its victim, never looses its hold until the life-juices have been sucked from it.

Are there any more interesting facts about the newt? Yes; the warty newt takes two years at least to come to maturity. During this time, in common with most of its relatives, it frequently changes its skin. As the young newt gets larger and larger, its skin stretches until it can stretch no farther; then the creature ceases eating; a new skin forms under the old one, which, as the two become separated from each other, contracts and cracks, the newt finally slipping out in its new dress, leaving behind the old one, filmy and slimy, but very complete and perfect. This goes on during the whole term of its natural life, although, as the newt grows older, the process is less frequently performed. In the late autumn the newt crawls into a hole or chink, or even into mud at the side of a pond or ditch, in which it hybernates, remaining in an inactive state until the

warm days of spring rewaken and revivify it, and drive it to its favourite pools again.

It is called the "warty" newt to distinguish it from some near relatives which have a smooth skin. When full-grown it is about six inches long, and its skin is covered with warts and pores. When young, the warty newt is very much like its smoother relations, illustrating again the natural law that the young of animals resemble more closely their oldest ancestors, whilst the adults resemble their more immediate progenitors; hence we may safely assume that it is a species of comparatively recent development, and that this has taken place from the smooth species which represent the older forms.

Well, we have spent a considerable time at this pond, and there are many interesting things yet to see in it, but we must not linger any longer now. A glance round the beautiful park, and our resolution to move on is shaken, for our attention is attracted by the hawthorns yonder. Large, regular trees, some of them are covered now with masses of summer snow, or clad in garb of brightest red.

Who does not love the hawthorn? Truly every healthy-minded inhabitant of our great cities must; for, are not the tender green leaves which it puts forth in the first warm days of spring, a sure harbinger of the speedy departure of winter, a certain omen that Nature has awakened from her long period of rest, that everything around us breathes of progress, is pleasant and hopeful. Does not the hawthorn in these early spring days—

> "When rosy plumelets tuft the larch,
> And rarely pipes the mounted thrush,
> Or underneath the barren bush,
> Flits by the sea-blue birds of March"—

remind us most forcibly that summer will soon be here?

In this pleasant spring-time when—

"The small birds rejoice in the green leaves returning,
The murmuring streamlet winds through the vale,"

FIG. 6.—THE HAWTHORN.

a, Blossom showing petals, stamens and pistil. *b*, Longitudinal section of blossom. *c*, Blossom with petals removed. *d*, Fruit. *e*, Section of fruit.

then—

"The hawthorn trees blow in the dew of the morning,
And wild scattered cowslips bedeck the green vale."

Are not its masses of summer-snow, and its powerful, far-reaching perfume, active symbols that the last traces of

winter are really gone, that summer is fully here? Do they not bring up reminiscences of the time when we—

> "Breathed forth the tender tale,
> Beneath the milk-white thorn that scents the evening gale"?

The name appears to have been derived from the Anglo-Saxon "haga," which means "a fence"; and "hagathorn" therefore means the "fence made of thorns." This form of the word appears to have been first changed to "haythorn," then to hawthorn. Certainly, whether it be as a tree standing alone, magnificent in foliage, and covered with heavy scent-laden blossom; whether it form a wild, unkept hedge, with long trailing lower branches and massy tops; or whether it be part of a trim well-kept hedgerow, its appearance is always welcome.

Here is a fine tree! How strangely the trunk is furrowed, and how marvellously it appears to have been twisted. It almost seems as if some giant storm had gripped the upper part of the tree, twisted its trunk almost to breaking point, and left it so. On this, as on the old tree hanging over the pond, the mistletoe has made its home. There is not a large mass of it, like those which hang from the apple trees in Worcestershire and Herefordshire, but a few sprays here and there, small straggling pieces coming out from cracks in the bark of the tree.

The Druidical association of the mistletoe with the oak tends to leave rather an erroneous impression on the mind. Here, in our Kent woods, mistletoe is very rarely found on oak; it is likewise exceedingly scarce in comparison with the profusion in which it occurs in some of our western counties. In some orchards in Herefordshire and Worcestershire, great plants, a couple of yards in circumference, hang

from almost every apple tree, and sometimes two or three occur on the same tree. Many other plants are attacked by this interesting parasite; an authority on the subject has told me of no less than thirty kinds of trees on which it has been found in these counties, including, besides the apple, which is easily first, six different species of poplar, the aspen, hawthorn, lime, white-flowering acacia, three species of maple, mountain ash, ash, willow, hazel, oak, sallow, sycamore, wild rose, pear, alder, medlar, wych elm, two species of horse-chestnut, and American crab. Such a list as this is very comprehensive, and, as in Kent, oak comes a long way down in order, when the number of times which each kind of tree acts as "host" is considered.

These parasitical plants are very interesting. The mistletoe, as we all know, has sticky white berries, which are eagerly sought after in the winter by birds for food. Frequently they fly with them to another tree, eat the pulp surrounding the seed, and leave the latter behind; this adheres, by reason of the viscidity of the particles of pulp still attached to it and the double anchors with which the seed is provided, to the branch of the tree where the meal is eaten. On the branch the seed germinates; a crack in the bark receives the sucker-like root, which soon penetrates into the meristematic or growing tissue of the tree; up this growing tissue the sap passes on its way to the leaves, and the sucker-like root of the mistletoe is thus enabled to absorb a part of the food which the tree has elaborated for its own sustenance.

But all parasitical plants are not so conspicuous as the mistletoe; on the contrary, many are excessively minute. The deadly diseases to corn crops, known as "bunt," "smut,"

and "ergot," are the result of minute parasitical fungi, whilst the "dodders," which cause great destruction to clover and allied plants, are also very small, making up, however, by their abundance what they lack in size.

FIG. 7.—MISTLETOE.
b, Staminate flower. *c*, Pistillate flower. *d*, Fruit. *e*, Section of fruit showing seed. *f*, Seed.

We have forgotten the hawthorn while we have been talking about the mistletoe, but we will now return to it. Look carefully at its blossom! In the unopened bud the five tips of the calyx stand out beyond the other parts of the yet folded bud. When the lovely white corolla unfolds

its pure petals, the calyx tube will bend back and become almost invisible under its snowy cap, whilst the stamens, with their pretty rose-coloured anthers, will surround the single style which rises up from the ovary in the centre of the flower.

Here are some flowers from which the petals have fallen. We know that these have been fertilised, because it is not until fertilisation has been effected that the petals and stamens drop off. If we look at these carefully, we shall see that the calyx remains persistent around the pistil, and helps to form at last the well-known red fruit with its central stone which is known to Kentish children as "haws," and, in a collective sense, as "hawsy-gawsies"; the children in some of our Northern counties call them "cat-haws," to distinguish them from the much larger fruit of the wild-rose, which they call "dog-haws," the names probably having originated from the difference in size.

Notice how very pink some of the blossoms are, and here is a tree, undoubtedly planted for decorative purposes, with masses of red coral-like blossoms, each flower of which has a double row of petals. This is the gardener's production. The second row of petals is formed of altered stamens; the colour has been obtained by careful selection. A branch has borne flowers showing a tendency to become red in colour; graftings from it have been made, and the seedlings of the resulting tree, which have shown the most pronounced tendency to bear red flowers, have again been selected; and so on, year after year, until an entirely different-looking flower has been produced. But even among this mass of red bloom we see up yonder a branch bearing bunches of flowers almost white, showing that even now the plant has a certain

ability, power, and tendency to revert to the condition out of which it has been evolved by the gardener's skill, unless, indeed, it be a branch from the stock on which the red has been grafted.

The hawthorn calls up happy memories of May-day, when sports and revels centred in the may-pole, when—

> "Not a budding boye or girle, this day
> But is got up and gone to bring in may.
> A deale of youth, ere this, is come
> Back, and with white thorn laden, home."

It would be almost impossible now, in an average season, to gather a branch of hawthorn in blossom on the first of May. Not because the seasons have undergone any considerable alteration, although it appears to be one of the greatest pleasures in life to older people to keep the younger ones in mind that the summers and winters of to-day are not what they used to be when *they* were young, but because the seasons have been set back, as it were, by the hand of man. At the time when May-day revels were at their height, the first of May was later in the year than now. May-day fell then on what is now the twelfth, and not the first of May, although it was the first then.

Our astronomers were for a long time aware that our time had been lagging, and in 1752 the time, as told by the clock and calendar, was eleven days behind the time as told by the position of the earth with regard to the sun and stars. They discovered that by adding one day at the end of every four years to make up for the extra hours beyond three hundred and sixty-five days that the earth takes to move in its orbit round the sun, astronomical time was over-calculated, and that the error, small as it was each year, had grown to a con-

siderable total. At last this was set right by the day after September 2nd, 1752, being called September 14th. The next year, of course, what would have been, under the old calculation, May 1st was now May 12th, and May-day arrived eleven days earlier than in the previous year. But these few days make a great difference in the development of the hawthorn bloom, and although in average years now "may" can generally be found on the twelfth, it is very rarely indeed that it can be found on the first of May.

In this thick-set bush that we have been examining so carefully, and around which we have been gossiping so long, we now discover something. Protected by an endless number of sharp thorny spikes, in the centre of the thickly twined branches, carefully concealed from the most observant eye, is a bird's nest. Neatly made of hay outside, skilfully plastered inside with a thin coating of mud, smoothed with exquisite skill by the breast of the careful builder, dry and hard now by exposure, is a thrush's nest. In it are five beautiful blue eggs, finely spotted with black about their broader ends, and we know that in a few days the words of the poet will be realized—

> "Within the milk-white hawthorn bush,
> Among her nestlings sits the thrush."

No wonder the mother bird yonder has been so fidgety, now coming nearer, then retreating. Well, we have kept her in a state of excitement long enough, and will move off.

The Park stretches invitingly before us, but we have other objects of interest in view; we walk through the grass, but we are too early yet to disturb the *Crambus* or grass moths, which, with their wings carefully folded round a grass stem, mimic a node exactly, but later they will abound here; then

over the steps we go, and get back into the road again. This now begins to show less signs of hard wear: its edges are covered with springy moss and turf, whilst its gently sloping banks are violet-strewn or covered with bracken,

FIG. 8.—SONG-THRUSH (*Turdus musicus*).

and the trees overhead stretch from side to side, making a delightful shade.

We look up and find that a magnificent row of ash trees borders the Park. What a majestic tree the ash is! How graceful are its large pinnate leaves! How stately it is in its uprightness, towering upwards a hundred feet or more!

There are only two other trees whose leaves can possibly be mistaken for those of the ash, but they, as a whole, are so different, and belong to such different natural orders of plants, that the mistake is inexcusable. One of these is the elder, which resembles the ash in no other particular, the other the mountain-ash, which has perhaps obtained its popular name from its outward similarity. The stateliness of the young ash has been noticed by the poet, who sings—

> "She's stately as yon youthful ash,
> That grows the cowslip braes atween,
> And shoots its head aboon each bush."

In the winter and early spring, before the leaves appear, the tree is readily distinguished by the blackness of—

> "Its buds, on either side opposed
> In couples, each to each enclosed
> In caskets black and hard as jet,"

and, as the spring advances, the ash is in no hurry to clothe itself. In company with the oak, which also delays its leafing as long as possible, the ash stands bare among the fresh green foliage around it; and from the fact that sometimes the ash, and at other times the oak, excels in the dilatoriness with which it assumes its verdant mantle, a weather rhyme has been formed, which runs as follows—

> "If the oak is out before the ash,
> 'Twill be a summer of wet and splash:
> But if the ash is before the oak,
> 'Twill be a summer of fire and smoke."

As a matter of fact, it is very rarely that the oak does not leaf before the ash in our southern woods, and as a condition of splash is rather a characteristic of our variable climate, the first assumption in the rhyme comes true; whether the

latter half does so, except on very rare occasions, is more than doubtful.

Mythological references to the ash are not uncommon. Was not the immense spear of Achilles made from an ash-tree? and did not Virgil first name the ash, "Fraxinus, the queen of the woods"? although its common English name is probably derived from the Saxon word "æsc," meaning "a spear," to which use its tough saplings were so frequently and to such good purpose put. Was it not under an ash tree that the far-famed spring was hidden, for a drink from which Odin gave one of his eyes? and does not Scandinavian mythology relate that Odin made the first man from a piece of ash wood? It is very probable that its abundance in many parts is due to its connection with sacred themes, to its association with the religious rites of the savage Norsemen who, centuries ago, overran our country.

But we soon leave the avenue of ash trees. To our left stretches the Park, with its mighty trees and ancient memories. To the right the woods roll on past the old village of Shorne, and, with a break here and there, to within a short distance of Gravesend. What makes Kentish woods appear so charming as compared with those of most other counties? Probably it is because of the regularity with which they are cut down every ten or twelve years, when nothing is left standing but the old trees. This opening up of the various parts is followed by a wealth of flowers rarely to be equalled elsewhere. Here is such a clearing. What a gorgeous carpet of brilliant colour does it present to us! The prevailing tint is blue—speedwell, ground-ivy and bluebells filling up almost every available inch of ground, whilst interspersed with these are the pretty flowers of the early

purple orchis. Yonder, on the edge of the clearing, the blue gives place to a most delicate pink, where that "nymph of the wood and the forest glade"—the lovely wood anemone, reigns supreme. There, too, on the slightly raised ridges, where the

FIG. 9.—BLUEBELL (*Hyacinthus*).
a, Bulbous underground stem bearing true leaflets and parallel-veined leaves.
b, Flower laid open to show the attachment of the stamens.

soil is perhaps rather drier, delightful masses of the beautiful white blossoms of the stitchwort help to give variety to the charming scene. The trees and bushes which were cut down during the winter are now throwing up from their roots

strong shoots covered with foliage of tender and variously tinted green, the whole forming such a picture as the poet probably had in his mind's eye when he sang—

FIG. 10.—WILD ROSE.

b, Section of flower showing pistil and stamens. *c*, Hip of rose. *d*, Section of hip showing achenes.

"Bring orchis, bring the foxglove spire,
The little speedwell's darling blue,
Deep tulips dashed with fiery dew,
Laburnums, dropping wells of fire."

As we leave this delightful nook a cottage comes in sight, and we notice that—

"The honeysuckle round the porch hath woven its wavy bowers,"

whilst over the walls and in the garden are the most lovely roses, and wild roses festoon the hedges and woods around. Indeed, many of the hedges of this country lane might have been that which Keats described as—

"A filbert hedge with wild brier overtwined,
And clumps of woodbine, taking the soft wind
Upon their summer thrones."

For "filbert" we must read "hazel," and then the portrait is exact, for most of the hedges here are fragrant with the delicious scent of the honeysuckle, and o'erhung with the pendent branches of the brier.

Lovely rose! the floral emblem of England, the symbol of love, the ideal of beauty and of fragrance! Does not the poet give perfect life to the ideality of its fragrance in the beautiful lines—

"You may break, you may shatter the vase if you will,
The scent of the roses will cling to it still"?

Have you ever examined our wild roses? If not, do so as you take your walks abroad whenever and wherever you may find them. On dry sandy banks, especially near the seashore, grows a rose whose stem is thickly covered with slender prickles, and which has a large, solitary, cream-coloured flower. This is called the Burnet rose (Fig. 11). Then in our country lanes, more especially those of our northern counties, there is another kind which forms an upright bush about three feet high; its leaves are very hairy, and its flowers appear very early in the summer. This is well

named *Rosa tomentosa*. In another group of roses we find

Fig. 11.—Scotch or Burnet Rose (*Rosa spinosissima*).

that the leaves are densely clothed with minute red glands

which, in the case of the eglantine (or, as it is more generally called, the sweet-brier), give out a delicious odour. In another group the prickles are thickened at the base and hooked at the tip, and to this group the common dog-rose (*Rosa canina*) of our hedges belongs. Its lovely, delicately scented clusters of flowers have charmed us during our morning's walk, and its bright red "hips" give colour to the hedges during the dull winter months.

The red hips are the fruit of the rose, and are very interesting botanically. A true fruit is really a ripened ovary; but in some plants, more particularly those belonging to the same natural order as the rose, and which has been well-named *Rosaceæ*, other parts of the flower help to form the fruit. In the wild-rose flower, the calyx remains adherent to the pistil after the stamens and petals have died off. This calyx continues to grow, and encloses the ovary in its rapidly increasing cells. When at last the fruit is perfected, it is composed essentially of this enlarged calyx, the true fruits being the pips inside the "hip."

The hip of the rose is, however, not the only fruit thus formed. The fleshy parts of the apple and pear have been similarly developed, and are simply swollen calyces, the pips being the true fruit; whilst the edible part of a strawberry is, in fact, only the enlarged receptacle or base on which the flower is placed, the true fruits being the minute, hard, cell-like *achenes* scattered over its surface (Fig. 12).

Nowhere are roses so abundant as in our country—

> "Where the rose in all its pride
> Decks the hollow dingle side,"

and it is no surprise that poets innumerable have sung their praises. Burns writes—

"O were my love yon red, red rose,
That grows upon yon castle wa',
And I mysel' a drap o' dew,
Within her lovely breast to fa'."

FIG. 12.—WILD STRAWBERRY.
b, Fruit. *c*, Section showing swollen receptacle bearing achenes.

How have our garden roses been produced? By the selection of cuttings from those plants which showed a natural tendency to change some of their many stamens into petals. The Great Mother always works towards simplicity, but in Nature, nevertheless, nothing is fixed, nothing is constant. Every kind of living plant and animal shows

some variability in its composition, and in roses, as in many other plants, one of the most ordinary modes of variation is for a stamen to become a petal. But the stamen is necessary for the reproduction of the flower, and hence Nature does not allow this variation to go on to any great extent. We find, however, that some plants have a greater tendency to undergo this change than others, and man, by selecting such plants, increases such inherent tendency in the flower. Take a common garden rose; instead of the five simple petals and hundreds of stamens of the wild rose, the petals are here innumerable, the stamens few in number; and if you pull asunder one of these flowers and carefully examine the petals nearest to the centre of the flower you will frequently have difficulty in determining whether they be really petals or stamens, since they partake of the structure of both. Nature always varies, as I have said; she is never constant. Man seizes on any variable element, and is able to turn it to his own use and purpose.

If we glance over the plant-world as a whole, we shall notice how true it is that Nature aims at simplicity of floral arrangement; those plants that are marked by this simplicity are, as a rule, the more ancient; those marked by complexity, in which some special part of the flower has undergone modification, usually in order to allow some particular insect or insects to carry out the work of fertilisation, are the more modern. As we examine these modifications, by means of which a more perfect result is obtained by Nature's humble servants, we feel with the poet that—

> "There's not a flower
> But shows some touch in freckle, streak, or stain
> Of His unrivalled pencil."

Rose trees sometimes live to an enormous age. At Hildersheim, in Germany, there is a historical plant which it is calculated, on the very best authority, must be over one thousand years old, and is still quite vigorous. Rose-blossoms, however, soon come to grief, and last but a very short time. The old couplet—

> "The rose has but a summer's reign,
> The daisy never dies"—

illustrates this well. So also does the poet when he sings—

> "Gather ye rosebuds while ye may,
> Old time is still a flying;
> And the same flower that smiles to-day,
> To-morrow will be dying."

Here are some strange-looking structures on the rose. Bright red, feathery cushions! What can they be? "Robins' nests," the boys call them, the "bedeguar," they are called by more scientific persons. They are plant galls, and are formed by a tiny insect. The insect punctures the stem to lay its eggs. Around the puncture thus made the sap collects, and a mass of cells is formed. These cells increase and multiply until at last the bedeguar in its full rich red dress is produced. Oak-apples, the tiny pimples on various leaves, and the marble-like excrescences growing from stems or on roots are also the result of insect action, and, diverse as they are in structure, form, size, and shape, are roughly grouped as Plant-galls. Each particular kind of insect gives rise to its own particular kind of gall, and since the number of insects which thus injure the trees and shrubs is very great, we find a very large number of different kinds of plant-galls.

We cannot leave the rose without referring again to its odour, and to that costly distillation known as "attar of roses," which is manufactured in the enervating atmosphere of Oriental cities. It has been stated that two hundred and fifty pounds of rose petals are required in order to produce a single ounce of this perfume, that one hundred thousand flowers at least are required for three drachms of this exquisite extract, of which three-tenths of a drachm is valued at ten pounds sterling. But it seems desecration to mix up such sordid thoughts with one of Nature's most delightful products.

The scent of the rose calls to our minds the odours of other woodland gems. You are getting tired? Well, let us choose a dry and shady spot on this bank under the shade of the trees, and rest awhile. We were referring to the perfumes of flowers. How excessively varied they are! There can be no doubt that it is to the delicious scent which they diffuse, that many of them owe the attractiveness which they have for mankind. But not only do flowers give off these delicate odours, but leaves and other parts of various plants also give forth perfumes which make them attractive and interesting to us. How rich is the scent of lush woodbine! How charming the delicate odour of the sweet-brier! In the one the flower is the seat of the subtle, all-pervading force which strikes upon our senses; in the other, the leaf is covered with delicate glands which secrete that scent of marvellous sweetness. Indeed, is not every spring and summer breeze laden with—

> "Many a wild perfume,
> Greeting the wanderer of the hill and grove
> Like sudden music?"

Does not the richly scented hawthorn bush woo our stay? and—

> "On the upland stile embowered,
> With fragrant hawthorn, snowy flowered,"

do we not with the poet "sauntering sit"? How often have we reclined on a moss-grown bank to drink in the scent of the violets hidden in the grass, or stood lingeringly by a rose-bush, only leaving it in quest of another? But, beyond all, what clouds of fragrance are borne on the air from a bed of mignonette! How unattractive is the bloom of the latter, judged by its appearance, described by the poet as—

> "Mignonette's meek, humble form,
> Without one tint upon her modest garb
> To draw the idle stare of wandering eyes!"

The poet, however, passing from the unattractiveness of the flower's appearance, soon hits the secret of the delight with which we hail its presence, for he sings—

> "Yet rich
> In precious fragrance is that lowly one,
> So loved for her sweet qualities, that I
> Should woo her first amid a world of flowers."

We are apt to think that everything beautiful and delicious in the field of Nature has been made specially to delight and charm our human senses, and there is a faint suspicion that a flower has not fulfilled its highest functions unless we are cognisant of its existence, in the lines—

> "For many a flower is born to blush unseen,
> And waste its sweetness in the desert air."

Let us see whether we can discover at least some of the uses of scents in flowers. Have you ever heard of the

wonderful keenness of the sense of smell in insects? Watch yon white butterfly! It is flitting along the hedge, but suddenly leaves it, as a piece of white paper is gently blown by the passing breeze along the road. The butterfly flies to the paper, toys with it, leaving it only to return again and again. Catch it carefully! Do not injure it! It is the Small White butterfly (*Pieris rapae*). Whatever did it mean by fluttering so lovingly around a moving piece of white paper? Ah! there are two other butterflies of the same species really love-making. The male butterfly flutters about and postures himself, evidently to make himself

FIG. 13.—THE SMALL WHITE BUTTERFLY (*Pieris rapae*) MALE.

agreeable to his lady-love, but the piece of white paper is gently blown along the road again, and he leaves the lady to toy around the piece of paper as his predecessor had done. He flutters and postures around the piece of paper as he did about the lady, and appears to detect no difference between the shadow and the reality. Once or twice he approaches the paper with his antennæ, and then in a very short time he satisfies himself that the paper is a fraud and delusion, and flies off. The female butterfly still lingers on the hedge-side yonder, and soon the recreant and fickle knight spies her, and love-making recommences. Strange, you say, that

the white butterfly cannot distinguish between a piece of white paper and a lady of its own kind; but so, at first, it really was, and only a close inspection with its antennæ enabled it to discern the difference.

If you examine carefully the butterfly which you captured, you will find that its eyes are large and well developed; each consists really of quite a mass of eyes, all bound together, each of which has a separate hexagonal facet, the surface of the compound eye being strongly convex. Yet with such an apparently well-developed eye, the organ as an optical instrument is very defective; practical experiment has proved that with the exception of a remarkable power to discriminate masses of colour, of a keen appreciation of slight differences of light and shade, and of an ability to recognise objects in motion, the eyes of most insects are practically useless, and so far as the sight of the white butterfly is concerned, we have seen that it is attracted by anything of its own colour as quickly as by a female of its own kind.

You may let the butterfly go now, and watch the female fluttering along the hedge. Every white or yellow flower appears to attract her. She hesitates, stops, hovers, but goes on, then slackens again for a moment, and at last comes to a final stop on a leaf of hedge mustard. Her body is thrust down on the leaf and then quickly raised again. She passes to another leaf and then flutters off, again hovering over a variety of flowers, never settling though until another cruciferous plant is detected, and then down goes the abdomen and another egg is deposited. Never by any chance is the insect at fault; no egg is laid except on a plant that will serve as food for the young caterpillars. Even to us many of the plants appear to be very much alike, and if the insect

made its selection by sight it would have to be conceded that it was a better hand at the business than a trained botanist. Probably the butterfly only emerged from the chrysalis this morning, or at the earliest yesterday; how then has it attained this degree of skill and perfection in so short a time? Its sense of sight we believe to be very imperfect, and we do not consider it possible that the insect selects the plant by its aid. But on the under side of its antennæ are a vast number of tiny pits from which nerve fibres pass to that part of the insect's nervous system which we believe to be in some degree analogous to the olfactory lobes of the higher animals, and we are at present inclined to consider that the selection is made by the sense of smell, if made by means of any sense of which we are cognisant.

Now let us turn our thoughts to a few of the most highly scented flowers. We have already seen how simple and inconspicuous are those of mignonette. How readily they might be overlooked if not made so attractive by their delicious perfume. The violet also has to be sought if we wish to find it, and so have many others of our richly scented species. These are only selected as examples, but very many of our most inconspicuous flowers are strongly scented. Not, indeed, that their scent is always agreeable to our senses; on the contrary, it is often far from pleasing; but the fact remains that most showy flowers are, as a rule, less distinctly scented, frequently also less richly supplied with honey, yet what rich store of the latter do the inconspicuous flowers of sallow, ivy and holly contain.

It has been agreed by botanists that, to a large extent at any rate, the highly ornamental corolla has been developed to form an attraction to insects, so that the most important

functions of the plant, the fertilization of the ovules and the final production of seed, may take place. It is well known that very few flowers, even if they are capable of so doing, fertilize their ovules with their own pollen, and generally the arrangement of the parts of the flower is such that self-fertilization is impossible. An intermediary is necessary to carry the pollen from one flower to another, and such Nature provides in the numerous army of flower-loving, flower-haunting insects. The general colour of the flower first attracts the insect whose sense of sight is keen enough to enable it to distinguish a mass of colour; the insect once attracted, the contents of the nectaries of the flower are sufficient to keep the visitor, and as the latter rifles the flower of its honey, it carries the pollen from one flower to another, and fertilisation is effected. But in plants with inconspicuous flowers the attractiveness of the corolla is at its minimum, and does not count, and then Nature finds other methods of attracting visitors to do the necessary work. In the light of our present knowledge we believe that the sense of smell is highly developed in insects, and we find that Nature takes advantage of this, and produces odours in flowers which direct the insects to the treasures hidden within the flower.

The leaves of plants also all have their own inherent scents, and differences, inappreciable to our coarser senses, appear to appeal distinctly to various forms of insect life. By this means we believe that the butterfly discriminates and selects the plant on which she lays her eggs, and in the same way we suppose that other insects are attracted to the honey stored in the nectaries of flowers, the getting at which ensures the fertilization of the ovules, and finally the propagation of the plant. That the perfume of a plant, be it

pleasing or the reverse to our own sense of smell, is of advantage to the plant, or subserves the purpose of attracting attention to it, we must, I think, be forced to admit.

We have considered how frequently plants with inconspicuous flowers are provided with the most powerful odours, but it would appear also that flowers with the sweetest perfumes are frequently also those of the simplest colours. In the progress of the development of colour in flowers, the order in which the colours are arranged, commencing with green as a base, is usually as follows: green, yellow, white, pink, red, blue—green being considered the primary or simplest colour in floral development.

Few of our sweet-scented flowers are blue in colour. Of course we call to mind at once the violet and bluebell, but it is difficult to find many others. Among the reds we get more, but the number is still comparatively small. It is the white flowers, and those with the tints of pink and yellow scarcely removed from white, which give the greatest number of our most deliciously scented flowers. The narcissus, lily of the valley, meadow sweet and clover at once occur to us among the white ones; the honeysuckle and primrose, among the yellow; the wild rose, among the pink.

The odours of flowers appear to become more powerful in damp weather, probably because they are then more readily diffused. It is then that the scent of the sweet-brier is wafted far and wide; and when we consider that our western winds are usually moister than those from any other quarter, we can readily understand the poet when he sings—

"Our sweet autumnal western scented wind
Robs of its odours none so sweet a flower,
In all the blooming waste it left behind
As that the sweet-brier yields it."

But it is very probable that the scent of the sweet-brier, produced in the tiny scent glands in the leaves, as well as the odours of many other plants in which an aromatic oil is a distinct element, are useful to the plants by preventing the attacks of many animals that would otherwise injure or destroy them. In this class the delicate odour of the pine-tree, with others of a resinous character, may be placed, as well as those of tansy, garlic and similar strongly scented plants which are particularly free from the attacks of animals, and eschewed by them as food.

Well, we have been resting long enough, and rise refreshed from our seat among the bracken. The scenery now becomes more and more distinctly woodland. The roadside banks are topped with ledges made by the roots of trees, which bind together the sand and pebbles there, whilst the lower part has been washed away. Hazel, birch, dogwood, sallow and wild roses make up the greater part of the undergrowth, whilst our woodland songsters abound and charm us with their melody.

We now pass the main road that leads to the village of Shorne, and notice an old-fashioned gatehouse, but our path still maintains its general character. On one side is the Park with its magnificent trees, on the other, woods rich with a great wealth of bird-life. Here one may occasionally see the honey buzzard, which is very destructive to bees; and that reminds us of the havoc that our little friend here, the blue-tit, will work. Have you ever watched this impudent little fellow tap a hive to make a bee come out, and as soon as one appears, pounce upon it and devour it? Where did that one come from? Ah! here is a hole in the sand-bank, well protected by the over-hanging ledge. Let us peep in!

What a collection is here! A mass of feathers and moss carefully lined with hair, in which are a number of eggs. We count one, two, three, . . . eleven beautiful pinkish white eggs. What is that at the back of the hole, spitting and hissing as you put in your fingers? It is the mother bird, who pecks you repeatedly, and will not leave the nest in spite of your interruption. You withdraw your hand; she ruffles up her feathers and settles down upon her eggs again at once. Timid little birds enough at ordinary times, they display an immense amount of pluck when sitting.

What useful little creatures these soft-billed denizens of our woods and gardens are! Watch one on an apple or pear tree in very early spring; it clings to the rough bark and looks keenly into every cranny and at every bud; the number of stoppages it makes will give one a notion of the work it does, as it clears out some noxious grub or insect every time it pauses. In this hawthorn hedge there is quite a family of birds—tits, robins, wrens and finches—all hard at work. The hawthorn looks in a bad way: the twigs are almost bare, whilst the leaves that are left are rolled up. Here and there, too, large masses of silky web are conspicuous, stretching from branch to branch. Carefully open one of these webs. A large number of leaden-coloured caterpillars, with large, round, black spots come tumbling out—not in ones and twos, but in dozens. There must be many thousands of caterpillars in this hedge, and yon crab-apple tree is covered with similar webs. This is one of our most destructive caterpillars, and produces a small grey or whitish moth, covered with tiny black dots, which is sometimes known as the Small Ermine moth. It is the caterpillars of this moth that spin their webs on the apple trees in our gardens, and do so much harm to them.

Now unroll one of the twisted leaves. Another caterpillar comes wriggling and twisting out; and when you open other leaves, out come more caterpillars. These are not the same as those we found in the web, for they are pale green in colour. They are called *Tortrices*, or "Twisters"; you understand at once why, when you see these caterpillars twisting up the leaves of the trees and shrubs on which they live, and on which they carry out their work of destruction. In the leafy month of June they are sometimes to be found in incredible numbers; but they constitute the food with which Nature supports a vast family of her bird children; and just now, when wrens, tits, nightingales and finches have their hungry broods to feed, these caterpillars have a bad time of it, and the trees and shrubs are thus saved from utter destruction.

Yonder is an immense oak-tree, perfectly bare. Is it dead? you ask. No; its leaves have been completely eaten off by the larvæ of another of these "twisters," called the Green Oak moth, or Pea-green Tortrix, from the exquisite tint of the moth. Let us stand under the tree a few minutes. Here, hanging by silk threads, floating gracefully in the air, ever and anon letting themselves fall to the ground, are the plump, fat larvæ; and here, on the honeysuckle bushes and grass at the foot of the tree, we find the rolled-up leaves in which the earlier caterpillars have changed to shiny black pupæ, which in a few days will give forth beautiful moths. These will, in their turn, lay eggs, the larvæ from which will carry on a similar work of destruction next year; so that, as we see, in spite of the wonderful energies put forth by the birds all around us, a vast amount of damage is still done. What would be the ulti-

mate result were the birds to cease helping us we dare not think.

What is that magnificent bird hovering above us? Can it be a peregrine falcon? It looks as if it might be, but it is too far off for us to be quite sure. See yonder thick-

Fig. 14.—The Peregrine Falcon (*Falco peregrinus*).

billed bird. It is a hawfinch. What an ugly head! you exclaim. It is, indeed; but its beak is made for use rather than ornament. Is that a ring-ouzel flying across the road? It is just possible, for it occasionally remains here through the summer, instead of returning to its more northern home to breed. A pheasant whirrs up almost from under our feet

as we leave the path and force our way for a short distance into the wood, and is soon followed by another, and yet another. They are very abundant here, being very strictly preserved. What is that creeping along so stealthily, and at last taking to flight as you press after it? Surely it is a quail. It is rather a rare visitor here, but probably some have been turned down in the woods. Let us try back, and

Fig. 15.—The Hawfinch (*Coccothraustes vulgaris*).

see whether we can flush another. No, we have spent some minutes now without result, nor can we find a nest. Yes, here is one, in a hollow under this bush, with five pale creamy-coloured eggs with red-brown markings in it. Evidently our guess was correct; and see, there is another bird creeping away. It is pretty evident that they are protected here.

We now reach a point where the road divides, one part

leading to Gravesend, and here we are near the far-famed and lovely beds of rhododendrons. We cannot go and see them to-day; they must have a separate visit, and they are well worth it. Great masses of vivid blossom stretching far and wide in every direction; the bee-hawk moth sucking honey from the deep tubular nectaries, its tongue driven down into the flower, whilst the moth remains almost motionless, upborne by the marvellously rapid vibrations of its wings; the sun falling in drops of light through the leafy masses of the oak-trees on the moss-grown paths below—all these combine to make a most charming picture. We still keep along the road to Cobham, now and again diving into the woods as objects of interest come in sight.

Here, in this yew tree, is something worthy of our attention. Almost hidden by the thick dark leaves of the tree; suspended from a slender branch, around which it is woven with amazing skill and dexterity, until the branch forms part of the roof, the remainder hanging suspended below in the form of a large oval ball with a tiny little hole on one side for entrance: the inside warmly and carefully lined with a thick bed of softest feathers; the outside beautifully woven with fine silken webs; the whole covered with tiny pieces of lichen which the busy little architects have pulled from the trunks of the neighbouring trees, is a gold-crest's nest. As it hangs pendent from the bough it appears a massive structure for such tiny birds to have made; but so carefully is it hidden, and so amply is it protected by its lichen covering, that it can only be detected with difficulty; and so remarkably beautiful is it withal that one cannot fail to admire the marvellous work of such tiny builders. Pull the branch down carefully. Ah! we have disturbed the

little mother, for she flies out of the nest into the tree where we can hear her ceaseless twittering. Don't touch the nest so as to disturb it in any way, or she may forsake it. A finger cautiously inserted enables us to count one, two, three, four, five, six, seven eggs; they feel scarcely larger than large peas. Yes, you may look at one if you do it carefully. Pretty little eggs they are, with a reddish tint at the broader end, although the ground colour is only drab. Put it back tenderly, and then let the branch gently back into position, so as not to jerk the nest. We will sit down for a few moments and watch. Yes, there is the little mother creeping back. See, she is just entering the nest again. Undoubtedly she is sitting; in a few days how busy will she and her mate, whom I see keeping a watchful eye over the nest from the bough above, be, catching myriads of small flies and other insects to feed such an array of hungry mouths.

A break in the wood discloses a rough piece of ground bordered by a tall, straggling hedge. A strange bird skims rapidly along, and a suspicion is aroused that it is the red-backed shrike. Back it comes, and the suspicion grows into certainty. We may be able to find its nest, but we shall have to watch closely and wait a considerable time. Let us take up a position behind this bush, so that the bird can carry on its operations without being disturbed by us. Lie down on the ground, and bring your field-glass to bear on the hedge. Ah! here comes the male bird, skimming along the hedge, just clear of the bramble and hawthorn branches that hang dangerously along the side. Yonder it disappears, and does not seem to return again.

There is a hedge-sparrow perched on yon hawthorn

branch, singing quite merrily. Suddenly a heavy body is projected against it, which knocks it into the grass at the foot of the hedge. Don't go near it. Do you not hear it screaming? Wait a moment. The bird appears to rise again, but it is bringing up something with it. Not *the* bird, though, for the object being carried up is the hedge-sparrow, quite dead now, whilst the bird that flies up to the very branch so recently occupied by the sparrow is the

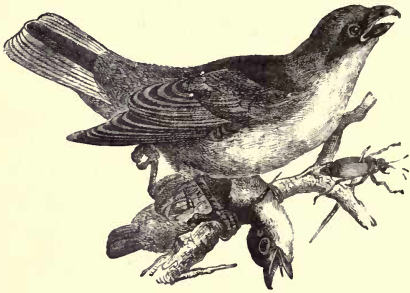


Fig. 16.—Red-backed Shrike (*Lanius collurio*).

dreaded butcher-bird. He holds his victim there for a few moments, and then is off to that bramble-bush. Watch him as he draws the hedge-sparrow up and down over the bramble thorns, until the victim is firmly fixed thereon. Now he is off. Wait a moment before you go too near. We were right to wait, you see, for he is returning and bringing his mate with him. And now the two indulge in a thorough orgy; up and down, round and round, they flutter and scream—now nearer, then farther away, now

advancing, then retreating. Then the hen bird catches hold of the victim by the head, while the male seizes it by the wing, and together they fix it more firmly. Now the hen is plucking the bird, and soon her beak is plunged deep into its body, and she fills her mouth with flesh. Off she flies, and enters a thick hawthorn bush higher up. Faint cries are heard, from which we know that she has her nest there. She returns again and again, the male meantime keeping watch. Now we really must disturb them; off they fly as we approach the hedge. From a small bush of dogwood at our feet, almost covered with long grass some two feet high, another hedge-sparrow gets up, and near the root of the bush, well protected by the grass, is the nest with its young ones, now, alas! fatherless. Here, indeed, is a direct illustration of the poet's lines—

> "The mayfly is torn by the swallow,
> The sparrow is speared by the shrike."

I have witnessed similar incidents before, and I know that in a few days Mrs. Hedge-sparrow and the young sparrows will all have followed their father to his doom.

Now let us have a look at the shrike's nest. What a perfect shambles the immediate area round it presents. The nest itself is artfully concealed in the bush, but the bottom of it is filled with the hard parts of beetles and butterflies and the bones of young birds. On the ground under the nest there is a perfect litter of the same kind of rejectamenta, bearing silent witness to the destruction which a single pair of birds can do whilst bringing up their hungry brood.

Still under the shade of magnificent oaks and lordly chestnuts, of majestic ash trees and graceful birches, we wend

our way, the Hall in the Park now continuously in sight, until at last we find the woods to the right hand becoming broken, and cultivated fields taking their place. On the other side of the road, a row of pine trees, apparently not in the best of health, offers a nesting place for turtle doves, as the noisy way in which they leave their nests testifies. Soon the chimneys of several cottages appear in sight, and, as we turn to the right, we enter the little village of Cobham. We soon travel the length of the clean little street, and in a few minutes are safely housed in the far-famed Dickens room, at the world-known hostelry, The Leather Bottle, and examine with interest the mementoes of one with whom all human nature must ever remain in sympathy. A few minutes, and we are paying our very best respects to a well-earned repast. Communion with Nature is apt to give zest to, rather than to detract from, the keenness of the appetite.

Lunch over, we lounge for a short time in the old churchyard, and worm our way through the little gate into the courtyard, beyond where are the almshouses, a quiet retreat for a few aged people. How quiet and peaceful the old square looks; a perfect haven of rest under the shadow of the peaceful church by its side.

Returning through the village, we pass by the top of the road by which we entered it, and, glancing at the long avenue of trees leading to the Hall, go on into the Park, through which we intend to make our return journey. A footpath runs through it, and is continued on into the woods and over the fields, finally emerging towards the bottom of the hill whence we started this morning.

Refreshed by our meal, we step out quickly for a short distance on the springy turf and yielding moss, the Hall

looming in sight, but not attractive, except for the beauty of its natural surroundings. Lovely green sward, mighty trees, deliciously scented blossoms, acres of young bracken fronds in which the deer love to roam and hide, are all around. Yonder is a small herd of deer, with a few young fawns gambolling about. Ah! they spy us out, and off they amble into the bracken, and are soon hidden among the lovely trees and young fronds.

What magnificent oaks are some of these we pass! The light still shimmers in golden drops between the lovely pale-tinted greenery of the early foliage. The dense dark leafage of summer, which gives such grateful shade in the hottest part of the year, is not yet formed; everything as yet tells of spring. The tiny young plants growing in millions from the kindly earth which has embosomed them during the darksome days of winter; the pale vernal foliage in all its bright young beauty; the delicious perfume of the blossoming trees; the sunlight dropping between the leaves in waves of dancing mellowed light; even the perfume of the earth itself; all make one feel that a re-awakening has come, and in spite of the outward signs of approaching age, man himself feels young again.

But to return to the grand old trees, of which the poet sings—

> "Three centuries he grows, and three he stays
> Supreme in state, and in three more decays."

And is not this majestic monarch of the forest—"sole king of forests all," as the poet calls it—the natural emblem of the sturdiness and manhood of our own nation? What historical associations of our dear old island home cluster round its memory! As we gaze at the oldest of these mighty

trees, our thoughts go back to a time far exceeding the nine hundred years allotted by the poet, and we wonder whether the white-robed Druid priests and the spotless oxen stood, and whether all the attendant ceremonies ever took place upon this very ground where now we stand; whether here, indeed, were—

> "The sacred oaks,
> Among whose awful shade the Druids strayed
> To cut the hallowed mistletoe, and hold
> High converse with their gods."

It may have been so; at any rate, we feel more serious for the thought.

Other thoughts which follow, are, however, based on surer ground. The value of the oak as a timber tree is exceedingly great. To this day the oaken stakes driven into the bed of the Thames and other rivers for the purpose of stemming the ever-advancing wave of Roman invasion, are occasionally dug out almost as sound as when driven into their watery resting-places; whilst the masses of oak dug out of our bogs, and which must have been buried, not only for centuries, but for thousands of years, appear to be almost imperishable.

Observe closely these trees. They have the ends of their twigs covered with a profusion of long, pendulous, tail-like catkins, whilst if you look carefully at one of the branches you will soon find that at the tips of the twigs are numerous scaly leaves or "bracts," in the centre of which a rounded cell is placed. Sometimes two or three of these are united to form a bunch. These are the female flowers, whilst the long catkins contain only the stamens or male part of the flower. The central cell of the female flower has a

short spike jutting from its apex, and we notice that some of these are sticky just now. The sticky surface readily holds such pollen grains as the wind may carry to it, and

FIG. 17.—THE OAK TREE.

a, Branch with staminate catkins. *b*, Staminate flower. *c*, Pistillate flower. *d*, Branch with acorns. *e*, Acorn and seed.

fertilization then takes place. The bracts round the cell join together and become hard and solid, the cell itself gets larger and larger, and in time the whole forms an acorn, the

cup of which is made of those altered bracts, while the cell forms the central nut.

Tap a branch of one of the trees bearing the male catkins with your stick; a perfect cloud of dust flies from them. Each particle of this dust is a living atom, ready to fertilize the ovules, and thus to secure the perpetuation of its kind. Truly the primitive acorn cell and this minute pollen grain are infinitesimal beginnings; but from two such minute structures every oak tree has been formed, and the most complex living structures which Nature develops arise similarly from the union of two tiny microscopic cells.

We have not quite finished with the oak yet. We have referred to its association with the Druids, but other historical associations also cluster round it, some of which are mere shadows in the dim mists of antiquity. At Winchester is a famous table, 18 feet in diameter, reputed to be *the* "round table" around which sat King Arthur and his famous knights. This table consists of a single transverse section of a single tree. Near York, the famous Cowthorpe oak holds seventy people in its hollow trunk, and has a circumference at its base of seventy-six feet; and many others scattered over various parts of the country approach this in size.

Here is a very old tree, judging from its appearance. How seamed and scarred is its trunk! How thick the bark around it! This reminds us that a closely allied species grows in Spain, the bark of which is stripped off once in every eight or ten years to supply us with cork. Generally trees will stand about six or eight of these strippings, which, however, finally weaken them very much, and then decay sets in.

One wonderful lesson is taught us by the leaves of the monarch of the forest. When the plant is very young their margins are entire, with scarcely any deep indentations. As the tree gets older, the indentations become more and more marked, until we reach the deeply-cut leaves of the adult tree. These changes in the individual are supposed by scientific men to shadow forth the changes which the foliage of the tree has undergone during the countless ages of the past, until it has arrived at its present condition; pointing out how the simple becomes more complex as development proceeds.

We have wandered far from the path into the Park itself, but now we make for the path again. Here the oaks are replaced by large, leafy chestnuts; there majestic ash trees reach high above their neighbours. At last we hit the grassy track that does duty for a path, and on mossy banks we slowly saunter along under the delicious shade of the umbrageous foliage, the branches of the trees interlacing with each other on either side, and forming a perfect canopy above our heads. Moss-grown trunks meet our view everywhere, but the mighty trees shut out all but the twinkling shafts of light which are filtered through the occasional breaks in the foliage above, and give an extra tinge of life and beauty to this deliciously cool and pleasant spot.

Up yon oak tree runs a squirrel. What a nimble fellow he is! There is another going up the smooth trunk of that beech as if it offered a perfectly sure and certain foothold, and see, it runs out on yonder little branch, which bends beneath its weight, and appears as if it must give way beneath it. No; it is perfectly safe there, and now it runs along and comes partly down the trunk again, this time head

first. Do you notice, too, what a noise its claws make on the trunk as it scampers about? Ah! I see a suspicious-looking hole in the trunk of the oak, and as the tree does not look difficult to climb, I commence the ascent. It is harder than it looked though, but presently I am astride a great branch, at the base of which is the hole. Just what I expected! In goes my hand, and out of the warm nest of

FIG. 18.—THE SQUIRREL (*Sciurus vulgaris*).

dead leaves and moss a little furry ball is brought, followed by another and yet another. Three of them! What funny little creatures they are; but I must put them back, and down I go again. Before I have reached the bottom the mother pops into the hole to see that her charges have not been injured, whilst the chuckling cry of the papa squirrel, who appears directly afterwards, tells us that he is very happy to find that all is well.

Watch that squirrel on the oak branch as he sits on his haunches with something in his two hands, at which he is nibbling, and with his long, bushy tail curled well over his back. During these spring and summer months the squirrel is in clover. Leafbuds, bark, and fruits of various kinds do not come amiss to him. In the autumn he will vary his diet with hazel nuts, beechmast, and acorns, whilst he shows the greatest ingenuity in getting the fruits of the pine-cones from their hidden recesses. Fungi, too, sometimes form part of his bill of fare, and some observers bring the charge of bird-nesting against him. The eggs of pheasants, partridges, blackbirds, thrushes, woodpigeons, rooks and many other weaker birds are all laid under tribute by this marauder, and birds frequently show symptoms of the very greatest excitement when a squirrel suddenly appears in their neighbourhood. In the autumn, however, the squirrel thriftily lays up a store for the hard times coming. A hollow in a tree is sometimes chosen, and into this he garners acorns, chestnuts, beechmast and hazel-nuts; but sometimes he digs holes in the ground, and puts his treasures into them. Many a monarch of the forest has probably thus been planted by a squirrel, who had forgotten the hiding-place in the winter, or had not required its contents.

The squirrel, however, does not want much food in the winter. We have heard how the Polar bear feeds in the autumn until he can eat no longer and then hides in a cave during the dreadful Arctic winter, slumbering soundly, never waking, scarcely breathing, the vital functions reduced to the lowest possible ebb until the warm spring re-awakens him. We know that certain butterflies and moths that emerge from the chrysalis state in the autumn become

dormant in the winter, the circulation of the blood and respiration being brought almost to a standstill. The squirrel does not hybernate so completely as this, but he builds a large nest of sticks in the fork of a large tree, and lines it with moss and leaves; into this he creeps, sleeping sometimes for days at a stretch, but coming out occasionally for food and to bask in the sun, if the day be bright.

What a pretty fellow the squirrel is, with his reddish-brown coat and white breast and belly. Sometimes squirrels have grey or even white tails, whilst occasionally their fur is entirely grey, or, very rarely indeed, almost white. Sometimes, too, we may see individuals in which the hairs are almost equally divided between brown and white.

Now we go on again under the trees, their large boles giving origin to quite a girdle of short branches with delicately-coloured leaves. There, on yonder slope, in the large trees, is a heronry. The herons breed here year after year, and come back here night after night to sleep, after fishing all day in the marshes along the banks of the Thames and Medway. The old saying, "He doesn't know a hawk from a handsaw," is still the most contemptuous phrase which some Kentish people can use to emphasise the ignorance of any person in matters ornithological. The connection between a "hawk" and a "handsaw" is not at first quite evident, but it becomes clear when we know that the old name for the heron was heronshaw, and that the country people corrupted the latter to handsaw, so that the statement really means that the person in question does not know the difference between a hawk and a heron—an amount of immeasurable ignorance never, I presume, to be forgiven. A short distance farther and we reach some steps from which

a close fence leads off on either side, at right angles to the path we are traversing. This is the Park "pale" again—the boundary of the Park in this direction—and a footpath under the fence to the left leads directly to the pond where we stayed to examine the newts this morning. We climb the steps, leave the Park, and enter the wood. There is very little difference at first, the wood being still with only little brushwood, owing to the complete manner in which the massive oaks and chestnuts shut out the light. Acres of bracken extend under the trees in every direction, here and there interspersed with brambles which prove disastrous to the integrity of our garments, as an attempt is made to force our way through to reach a tree whose trunk we wish to investigate, and which is placed at some distance from the path. Gradually the large trees get fewer and the brushwood thicker, whilst the rays of the now rapidly westering sun fall slantingly through the opening in the trees upon our path. How beautiful are the sparkling rays of liquid light, dancing and shimmering through the greenery, and causing the leaves to throw trembling, fanciful shadows upon the ground. Here a mossy bank appears too tempting a bait to be neglected, and infinitely more attractive than the wooden seat at the top of the bank. Here we will lie awhile and admire and think. Presently we will go on again.

To the right of us is a pretty dell; indeed, an old watercourse appears at one time to have cut quite a deep valley through the wood at right angles to the path we have just left, and here are thorns and hazel-bushes, the former rich with a wealth of blossom, the latter lovely in the fresh green of their youth and beauty, whilst a little distance away we remember a nook where the charming lily of the valley still

lingers in spite of the havoc which ignorant people play with their trowels and baskets.

After a long rest we start again, and soon come across another woodland clearing. We have seen many beautiful pictures to-day, some charming us by their simplicity, others by their delicacy, but here we come across one which is almost startling from its brilliancy. Here, in this clearing, a bed of blue-bells stretches far, far away on either side of us, fading like a blue mist in the uncut wood yonder. Just such a picture as this Tennyson must have seen when he beheld—

> "Sheets of hyacinths,
> That seem'd the heavens up-breaking through the earth"—

and truly, nothing but the deep azure of a summer noon-day sky can give a more continuous sheet of glowing living blue. Scattered here and there are spikes of the early purple orchis, with its striking spotted leaves—the "ladies' fingers" of our country children—whilst the delicate tint of the anemone occasionally appears; but these are almost lost in that sea of brilliant colour.

We will sit on this felled tree and watch the sun set. All around us is a sea of colour; the fragrant scents of spring are borne upon the air and steal upon our senses; the sky is rapidly becoming tinged with orange and crimson, sure companions in a lovely sunset glow; whilst right ahead the trees throw their mighty branches overhead, forming a leafy canopy which fades in the distance into an avenue of more regular appearance. The shades of eve are falling fast. Longer and longer grow the shadows of the trees as the rays become more and more slanting. Gradually they blend with the surrounding light until they are shadows no longer.

The sun disappears, the Swallow-tail moth in its pale primrose dress, and some relatives with richer tints dart to and fro in the open rides. The light grows fainter and fainter, a dark shadowy body passes rapidly before our eyes, so quickly indeed that we are not quite sure that our eyes did not deceive us in the increasing gloom. The sky loses its blue and becomes darker and darker in tint, whilst yonder, towards the south, the planets and more brilliant stars become faintly visible, progressively increasing in brightness as the gloom deepens; shadows pass more frequently before our eyes, whilst the eerie cry of the nightjar tells us how busily it is at work. Between us and the sky other dark shadows are to be seen, standing out clearly, and marking the flight of many bats, whilst the descent of the pale yellow wings of the Swallow-tail moth tells on what they feed. True there is an abundance of moths here, but this is compensated for by the abundance of birds and bats which live on them. How clearly do we see again that the wood in which we rest is "a world of plunder and prey."

The gloom increases, the stars grow brighter and appear more numerous. The glow-worm crawls from her retreat and shows her pleasant light; but this only makes the absence of light and the solitude of the woods more complete. And now darkness reigns supreme. The pale-coloured moths are visible no longer, nor can we any longer see the ghostly shadows of flitting bats and nightjars, although the weird, uncanny cry of the latter is as frequent as ever, and together with the rapid vibration of their wings as they fly near us, appeals to our ears long after the creatures themselves have become quite invisible to us.

Let us go on! The path is straight and thickly lined with

the softest moss, into which our feet fall noiselessly, except when an occasional twig snaps under us. A glance now and then at the stars as they break through the leafy canopy overhead is sufficient to keep us in the right direction. Here, alone with Nature, we can find time to think. Slowly onwards we go, and at last reach the outskirts of the wood. A large pale shadow flits past, almost within reach as we stand at the entrance of the wood. Another night-worker at its toil, and taking its tithe of the living creatures of the earth—the barn owl—works most assiduously for its young. How softly it wheels to and fro as it keenly searches for its prey! Mice and rats form the staple of its food, hence its fondness for the neighbourhood of a farm. Its manner of nesting, or rather its manner of egg-laying, is very peculiar. The hen, after having laid two eggs, sits on them until hatched, as birds ordinarily do, but a day or two before these are hatched another pair is laid, and thus there are two young ones and two eggs in the same nest, the warmth from the first pair of young birds hatching the second pair. In turn two more eggs are laid just before the second pair of birds are hatched, and these in turn are hatched by their predecessors,—a wise provision of Nature which leaves both the parent birds free for a very considerable time at a stretch to get food.

Now we step from under the leafy canopy and find ourselves on the edge of the wood, which we skirt for some little distance, but in a short time we leave the wood altogether, and step smartly out across a hop-garden. How strange the poles look in the almost darkness! How still and peaceful is everything here! What a sense of sweetness there is in the air from the woods and from the soil, born

of the freshness of spring! Our eyes go up to the great vault above, and as we see a large hazy mass among the brighter stars, and recognise it as a probable nebula, our mind goes back to that time long, long ago, when—

> "This world was once a fluid haze of light,
> Till toward the centre set the starry tides
> And eddied into suns, that wheeling cast
> The planets."

Was ever a shorter and more definite account given of the "nebular hypothesis"? Was it ever so briefly stated? Bit by bit our minds go back from the solid world on which we stand, upward through the atmosphere which bathes it, through the region of wind and cloud and mist, until we reach—

> "That lucid interspace of world and world,
> Where never creeps a cloud or moves a wind,
> Nor ever falls the least white star of snow,
> Nor ever lowest roll of thunder moans,
> Nor sound of human sorrow mounts to mar
> Their sacred everlasting calm."

Yes, "an everlasting calm" runs upward and onward from world to world. We think of those vast gaseous masses slowly condensing, and in their revolution throwing off masses of their own structure, and then holding them in subjection by the law of gravity; the change from gas to liquid, from liquid to solid; the quiet, slow, silent work of the ages that followed, passes rapidly before our minds, and then before us rises the picture when—

> "This outworn earth shall be as dead as yon dead world the moon."

There is Jupiter, bright and clear; there Saturn, with its

luminous rings and many moons, which Tennyson compares with the lonely, studious man when he writes—

> "And while the world runs round and round, I said,
> Reign thou apart, a quiet king,
> Still as, while Saturn whirls, his steadfast shade
> Sleeps on his luminous ring."

All these bright bodies, moving in their elliptical orbits, in company with our own earth, around the central sun, derive their heat, their life from him.

With such-like thoughts our minds are filled as we walk over the fields in the balmy air, skirting a narrow copse, until at last we are on the borders of Strood once more. A stile at the end of a narrow path offers facilities for a final reverie. There is the old school, buried in slumber, and behind it the vicarage with its extensive gardens. How strange it seems that these old-fashioned schools are always in immediate contact with the parson's orchard, separated from it only by a five-foot wall! Is it to give the parson a chance of showing off his learning by everlasting discourses on the inherent wickedness of boy nature, or of obtaining satisfactory proof of the deep seated character of original sin in boy mind? It must be something of this kind, and if so, one's feelings rise in rebellion when the boy is flogged for delinquencies over which he has so little control; and still more erroneous does it appear that those who ought to lead our youth aright, should put temptation where it is so little likely to be resisted.

What amusing recollections does that old school bring back! It appears to have been the aim of a long series of well-meaning clergymen to bring up the youth of what was, some quarter of a century ago, a very sleepy village, in the

way it should go. For this commendable purpose a Sunday School was instituted. Not that the founders of the school ever went farther than collecting the necessary funds for its erection. Certainly not! They were too busy, and so the leisured schoolmaster, who had to eke out a paltry salary by giving music lessons every evening in the week, and took his recreation by doing the same on Saturdays, who had to play the organ on Sundays, and to train the village choir at such times as circumstances permitted, was requisitioned for the purpose, since it was found that he really had an hour at his disposal on Sunday mornings and two on Sunday afternoons. The schoolmaster must bring up the youth, and relieve those whose duty it should have been. To aid him in his work, three small boys, who were paid the princely salary of one or two shillings per week, according to age, were called in, with a bevy of maiden ladies, who pretended to teach the young, and did their best in the most awe-inspiring fashion, backed by the small boy monitors, who kept order in a very rough-and-ready fashion.

It was my lot to know many of the lads who enforced obedience to the commands of these ladies. Meek little boys they grew up, never dreaming of objecting to these hateful tasks. But presently two lads of different spirit appeared on the scene. Chosen for their daily avocation on the principle of setting a thief to catch a thief, the order they maintained was noteworthy. About this time the schoolmaster was relieved of his duties by a local tradesman, and the irksomeness of this Sunday police work began to pall on the boys who were left in charge. First one and then the other stayed away. Sickness of various kinds and degrees became rife on that particular day. Then at last revolt

broke out, and the two lads, boldly facing the situation, determine to go no longer. With several companions they go over the ground which we have travelled to-day. It is October; the ground is strewn with chestnuts just shaking free from the resigning husk. Over the public pathway through the Park hundreds of chestnut trees grow. The path is carpeted with chestnuts. Were not chestnuts made for boys to eat? This is so self-evident that a few are picked up mechanically and eaten, and as it is said one little pig drives down another, so does one chestnut drive down another. But the chestnuts are picked up faster than they can be eaten; first one and then another finds its way into a pocket, and at last, from the many bushels lying on the ground the pockets are filled. The boys are happy, care is thrown to the winds this lovely afternoon. But at the entrance of the wood they are startled by the appearance of a swarthy-looking keeper with a thick stick. The condition of their pockets pricks their consciences. A moment's consultation, a sudden rush, and the keeper is on his back in the road, whilst the boys are rushing over the fields we have just crossed. The keeper, incensed at this rough treatment, is soon in hot pursuit. Round the corner they come, the stile is cleared, and down the hill they go.

Alas! the irony of Fate! Sunday School is just being dismissed. The children line up to see the flying scud. The maiden ladies stand in pious horror. The new tradesman-superintendent looks on in despair, whilst his two sick boy-teachers, hats in hand, their coats flying in the wind, splashed with mud from head to foot, rush madly by with their companions. Only one person appears to be enjoying it. A dark eye twinkles with amusement from behind the ivy-

covered window of the school-house. At the bottom of the hill the flying boys disperse, and when the keeper reaches the four-wents way, not a soul except the jeering crowd of children is in sight. A jeering crowd of children is not a pleasant assemblage to be the butt of, and the soured keeper angrily hastens back to his duty, vowing vengeance on his tormentors.

Three hours later the greater part of that group of boys piously knelt in the choir in white surplices, praying heartily, "Lead us not into temptation," and chestnuts undoubtedly loomed visibly in mind, whilst, later on, as they sang, the singing appeared to partake of the hymns of old, which were raised as a pæan of victory. Next morning, however, after a stormy interview, in which "cancelling indentures," "immoral behaviour," "scandalous example," were conspicuous, and the loss of that princely salary of two shillings per week was vaguely threatened, a dark eye sparkled brightly, and a quiet, sympathetic voice said, "It's a great shame to make you go to school on Sundays against your wish," and it is needless to say those boys rarely went again. Did Nature make bright sunshine, lovely flowers and lovely nooks for lads to be engaged week-day and Sunday in pretending to teach children almost as old as themselves? I, for one, do not believe it. Verily, I've been dreaming on this stile! It is getting late, but the visions of former days, even at this far-off time, rouse my feelings to rebellion against such unnatural action.

Now down the hill we go, past the ivied school-house, under the magnificent horse-chestnut tree by the side of the road. How long, we wonder, can it be since here the—

"Drooping chestnut buds began

To spread into the perfect fan
Above the teeming ground!"

It must have been a long time ago now, for this tree is an old one, a perfect picture in early spring, when its masses of blossom form an immense nosegay, each blossom with a vivid red islet in its centre, a perfect shelter in summer from the rays of the burning sun. Into the town we pass. Large houses now replace the little cottages with their long front gardens, whilst the little green-shuttered windows on either side of the long straggling street have disappeared to make room for more imposing dwellings. The toll-gate, too, has vanished into the mists of antiquity, but home is reached at last. Here there is no change; the same cheery faces, the same welcome, the same happy sense of rest, greet us as of yore, and we feel, as we retire to rest, that our day's wanderings fulfil the condition of which the poet speaks—

"Something accomplished, something done,
Has earned a night's repose."

BURNSIDE.

FAINTLY outlined in the dim distance, rising mass on mass one beyond the other until lost in the almost darkness, the pale grey of early dawn creeping slowly downward from their summits, stand the mountains. A slight rosy flush, heralding the advent of the sun, lights up their peaks, and makes them more distinct. Nearer and nearer do they appear to come, until what were only indistinct cloud-like masses take form and structure, and prove their connection with mother-earth as they loom in the distance, shrouded in rich purple shadows. A few minutes later and the first rays of the approaching sun tinge and are reflected from their peaks, descending lower and lower down their sides as the red ball of fire creeps nearer and nearer to the horizon, and before long the last shadows of night have entirely vanished, and the whole scene before me is flooded with glorious light. The twinkling stars have one by one hidden their heads; even the brightest have at last disappeared. The deep purple vault takes on a brighter and yet brighter blue, and when the sun reaches the horizon, rich flashes of red and orange dance athwart the azure dome. At last the sun breaks forth in a refulgent glow, the bright tints disappear, a rosy haze takes their place on the horizon, whilst overhead

the blue becomes more and more intense, and a fine diaphanous haze alone leaves a suspicion of the night that has just departed.

A low, murmuring ripple of laughing water breaks on my ear, slowly changing into a noisy burst as I approach it, and eddying whirls breaking over each other in mad confusion are clearly pictured in my imagination. When I reach the little moss-grown bridge under which the mountain torrent hisses and boils and bubbles, dashing against the rocky masses in its bed to be thrown back noisily, whirling and gurgling, upon the waters below, a pleasant roar of jocund screaming rises from the waters, shutting out all other sounds, and raising my spirits to the same exhilarating level that the water itself has reached.

For a hundred yards or so on both sides a narrow sward of greenest grass rises gently towards the foot of the mountains; from this spring large oaks and ash-trees, which rise proudly from their bright and grassy bed, and throw out their massive arms and interlace their branches to form a canopy under which the mountain torrent flows noisily, throwing its spray here and there upon the lower branches. Truly here if anywhere one feels that—

> "No spell could stay the living tide,'
> Or charm the rushing stream."

Below the bridge the bed widens, and the burn runs more slowly, soon terminating its existence by flowing into the broad waters of Loch Goil.

As I face the north a larch plantation breaks upon my view, backed by a dense thicket of pines, and farther behind, by a rocky mountainous peak. How brilliant is the green of the young shoots of the larch! What a contrast it pre-

sents to the sombre colouring of the overshadowing pines! What a magnificent picture the living tints of the one make against the dark background of the other, whilst beyond all, the rugged, rocky peak of the Highland mountain stands out to complete a picture of wild and living grandeur, where—

> "Dark tall pines, that plumed the craggy ledge
> High over the blue gorge, and all between
> The snowy peak and snow-white cataract
> Fostered the callow eaglet."

To the south of me is the broad Loch Goil, its rippling surface scintillating with thousands of golden points as it reflects the liquid rays of the morning sun now breaking over the top of Tom nan Gamhna. Very beautiful does the sparkling water look with its massive boundaries of rocky summits and its narrow strand edged with the verdant green of bracken, bush and tree.

As I look back along the course of the brook, I can spy among the rocks far up the mountain side, overhung with birch and ash, with hazel and thorn, a foaming cataract; its sound falls with a dull musical cadence on my ears, and forms a pleasing harmony with the sharp-toned notes arising from the bubbling torrent at my feet. And beyond all, with deeply cut chasm and rocky precipice, rises Ben Donich; a faint mist hangs here and there about its lower glens and valleys, but its peak sparkles through the rosy haze of the morning sun. Truly one might spend a long time here in such peaceful solitude, drinking in the beauty everywhere around. But time creeps slowly on. An occasional passer-by reminds me that "man goeth forth unto his work and to his labour until the evening." The sun rises higher and higher in the heavens, increasing in power as he ascends, and

slowly and reluctantly I wend my way back to the hotel at the head of the Loch, and join my friends at breakfast.

Breakfast over, we start for a climb, our destination being the cairn on the summit of Ben Donich. Passing the bridge on which I stood this morning, and under which the gurgling burn still noisily hurries, we bear to the right, our route skirting the larch wood and then leading us through a plantation of more mixed growth. Here a small party with rod and reel attempts to lure the wary salmon to his doom, but the bright August morning is evidently not propitious for such sport. After this we pass under a narrow belt of wood which skirts the base of Ben Donich, and enter it a little farther up to explore its mysteries. Carpet moths in numbers fly off the trunks of the trees as we push through the underwood, but we do not see them until they are on the wing. We stop and examine a tree. There is a patch exactly the colour of the damp oak-trunk. A shadow falls on it as we stretch forward, and in a moment the apparent patch takes to flight and is gone. Now we know what to look for. There is another patch just discernible on the trunk. Even the wavy lines of the trunk are continued on the patch. It is only a scar, you think. Move your hand quickly near it. It's off, you see, directly. There is a paler patch. With a little care you can see that that is a moth, even while it rests on the oak trunk; but it flies to yon birch, and on its trunk becomes as invisible as were the dark ones on the oak trunk. A little close observation soon reveals to us that there are both pale and dark moths in this wood, and that they are inconspicuous or the reverse, according as they rest on the birch or oak trunks; the pale ones are inconspicuous on the birches, but conspicuous on the

oaks, whilst the dark ones are inconspicuous on the oaks, but conspicuous on the birches.

Leaving the wood, we enter a large marshy field which skirts the road on both sides; this we cross to get to a little thickly wooded and well-protected dingle, down which another burn has cut its way from the mountain above. The sides of this are pretty steep, and the rock is different in this hollow from any we have seen here before. A mass of dark red sandstone has been cut through for a short distance by this noisy little stream, and the trees luxuriate here in the hollows where—

> "The scented birk and hawthorn white,
> Across the pool their arms unite,"

though the living, laughing burn bears little resemblance to a pool as it sparkles merrily over its rocky bed.

Up the watercourse we go, springing from rock to rock. The same species of Carpet moth that we saw in the wood just now, flies off from the rocky sides at our approach. There is one settling yonder. Keeping the eye fixed on the spot, we peer carefully at the rock where it settled, but can see no moth there. A slight breath, and what appeared to be a piece of rock lifts itself up and moves a foot or two away, then, dropping its wings flat upon the rock again, becomes almost as invisible as before. Almost, but not quite, for we are just able to trace its outline as a crack in the rock, and there is another and another. We have trained our eyes until they have acquired the requisite amount of skill, and now, when we see several similar-looking cracks, we know that they are Carpet moths. There is a tit hunting the mossy bank; every cranny and every nook appears to be explored, but even the tit is often deceived.

There are no pale or black moths here; all agree exactly in tint with the redder-coloured rock on which they rest. Black moths and pale ones would be equally conspicuous here; hence Nature has got rid of these forms, and produced a race which is better fitted to compete with its enemies in this sheltered nook.

Occasionally we miss our footing, but tread with more caution after drawing a dripping leg from its unexpected bath. At last we reach the top of the dingle. The course of the burn higher up is bare and precipitous, as it rushes through rocky gullies with here and there a solitary mountain ash or gnarled and twisted thorn standing in loneliness on the mountain side. But although we have ascended thus far, we are not going to attempt to scale the mountain from this side; so, skirting a boggy piece of ground, we keep a somewhat level track until we strike the path to Glencroe at a considerable distance ahead of and above the spot at which we left it.

As we look back to that part of the path which we have just skipped, we see that it skirts a little wood, the plants growing in which tend to prove the truth of the statement that—

> "The oak, the ash, and the bonnie ivie tree,
> Oh, they flourish best at hame in the north countrie."

From this point, too, we can see the base of the hills opposite Ben Donich thickly covered with a dark pine wood. The lovely sunshine brings to mind the contrast of the previous afternoon, when we were obliged to ask for shelter from a storm in a hut in that wood, and were thankful for the protection which was kindly afforded us in common with the poultry and other inmates. The rain fell in torrents, bright flashes of

lightning lit up the woods, and the thunder rolled and reverberated among the mountains. The scene was one of vivid brilliancy and grandeur. One does not rightly appreciate thunder until one hears it among the mountains, where it echoes and re-echoes in never-ending peals. The surroundings of a mountain district make a terrific storm really grand, although a certain amount of shelter is necessary before one is in a position properly to appreciate it. A sudden approach of two clouds, an increased amount of darkness, to be felt rather than recognised, and then a brilliant flash before our eyes startles us. One, two, three, four, five seconds, and then a low rumbling, breaking into a long-continued roar, which heightens into a terrific crash, falls upon the ear. The thunder really began at the same moment as the flash, and if one were unfortunate enough to be within a few yards of an electrical discharge, one would hear the thunder at the same instant that he was blinded by the flash. But sound travels more slowly than light, its rate being about 1,100 feet in a second, whilst light travels about 186,600 miles in the same time. The flash was seen by us then at the instant of its production, whilst as the thunder did not reach our ears till five seconds later, the discharge must have taken place a little more than a mile away.

But enough of yesterday and its storm. We keep to the road, which ascends rather rapidly. Passing Hell's Glen we see to our left a pretty waterfall, too far off to admire in detail, but forming a very beautiful picture at this distance. The foaming cataract precipitates itself over a rocky cliff, and afterwards expands into a broad burn, which joins the large one running along the bottom of the wooded gorge on the western side of the road. The noise from the smaller burn is

lost in the roar of the larger one, down to which a steep bank slopes from the left hand edge of the road. The right side of the road hugs Ben Donich, round whose northern side we now pass, and leads us some distance towards its summit, whilst Beinn an Lochain rises on the left to a height of nearly 3,000 feet. The road becomes steeper and steeper, whilst the mountains, which a short time ago looked far distant, come nearer, and hazy peaks become more conspicuous.

The climb continues, until at last we arrive at the highest point of the road. Directly before us on the east is the deep valley of Glencroe, a rocky gorge between the steep mountains which rise on either side. Some three hundred yards from where we are now standing the road divides, one branch going northward for a short distance past Loch Restil, then westward to Loch Fyne; whilst the other runs down Glencroe to Loch Long, not far from Arrochar. At the farthest end of the glen we can see the waters of the loch reflecting the golden sunlight. The scenery is rough and rugged, and these qualities compel our admiration; but there is very little beauty, owing to the almost entire absence of trees. The mountain bases, it is true, are covered with grass and bracken, but their summits are capped by masses of broken schist, which stand out bare and grim against the sky, the bright sunlight serving to bring into relief the massive rocks with the dark chasms that they hold and hide. For a few moments we gaze on this wild and savage spot; then turning to the right, step off the path and commence the real ascent of Ben Donich.

The upward slope looks easy and tempting; the ground appears firm and solid, and so for a short distance it is; but the yielding peat soon commences to dispel the illusion, and

the beautiful wavy cotton grass, with its fleecy masses floating in the air, is a certain signal that all is not what it seems. Above, leaping over the rocks, is the torrent which has formed this bog; not sufficiently powerful or permanent to cut a path for itself to the base of the mountain, it has collected here in a hollow basin of schist, and given rise to a morass, which is not at all easy to negotiate. Round the edge of the bog we pass, and soon reach a steep ridge, where rock-climbing becomes necessary, and from which we can see how large a part of the ascent the road enabled us to cover this morning. As we sit on a rock to rest, "The Cobbler" attracts our attention, whilst Ben Arthur and The Brack look quite near; the barrenness of Glencroe is, if possible, even more strongly accentuated, its steep rocky banks being entirely unrelieved even by a suspicion of wood to take off the lonely and weird appearance.

As we sit here we notice that a change is occurring in the weather; round the tops of the mountains fleecy films of cloud begin to appear; their lower surfaces, as yet, however, are bathed in sunshine. What makes the clouds collect about the tops of the hills, whilst the lower parts are clear? The clouds are formed by the passage up the mountain sides of vapour-laden air, which is cooled on its upward journey. This cooling is due not to the contact of the air with the surface of the ground, but to the expansion of the air itself as it rises higher and higher up the slope. As the air cools it cannot retain so much watery vapour in its meshes as it did when it was warmer, and the excess is exhibited in the shape of exceedingly minute drops of water, which assume the appearance of mist if we are in the middle of them, of clouds if we are a little distance from them. At the summit

the expansion is at its greatest, and hence the clouds collect there more freely than at the lower levels. When the summit is reached the air passes down the opposite slope of the mountain, it contracts again, becomes warmer in so doing, and the cloud diminishes, and presently vanishes altogether.

On the move again, up, up we go. As we look towards the summit, on almost every jutting crag we observe a mountain sheep standing, apparently fixed and immovable; but when we reach one of these crags we find that the sheep have taken up a still higher position, and are gazing at us with stolid wonder as before. The wild plover sends forth its shrill whistle, and tempts us to answer it. At length we come to a deep rocky glen with damp sides, from the crevices in which the saxifrage (*Saxifraga aizöides*) and the pretty little brittle fern hang temptingly. Up this we scramble, and come upon a flat boggy piece of ground, beyond which are wonderful beds of moss, into which the foot sinks noiselessly, and under which tiny streams of ice-cold water are ever flowing.

Up to this point the climb has been uneventful, and we have met with little specially to attract our attention. This side of the mountain proves at close quarters the accuracy of the general opinion which we formed of the barrenness of these mountain walls of Glencroe. The clouds begin to gather, or rather we begin to enter them, and for some little distance masses of trailing mist scud past us, enveloping us in their damp folds for a few minutes, and then leaving us bathed in sunshine as before. We are evidently in the zone where the clouds formed on the opposite side of the mountain are being dissipated.

Another steep ascent lies before us, and the rugged side has to be cautiously climbed. When we reach the top we find ourselves on a level surface of black schist, leading in front of us to the edge of a steep precipice. Out to the edge, leaping over yawning crevices on the way, my companions go and gaze into the depths below, whilst I take my view from a distance, and with infinitely less risk. We climb rapidly among large rocky crags towards the summit, resting occasionally as a mass of mist envelopes us in its descent, and going on again as soon as it has passed. The rock faces get more and more broken as we ascend, the jutting crags more numerous, the overhanging rocks more threatening, the precipices more dangerous, the crevices more yawning. Here, among these rocky masses near the summit of the mountain, we can picture, in times scarcely yet gone by, the eagle clasping—

> "The crag with hooked hands,
> Close to the sun, in lonely lands,
> Ring'd with the azure world he stands.
> The wrinkled sea beneath him crawls,
> He watches from his mountain walls,
> And like a thunderbolt he falls."

The soft rosy haze which toned down the ruggedness of the mountain in the early morning has entirely disappeared; the picture now unfolded before our eyes is one of wild and savage grandeur; stern, unyielding and tumultuous rocks and precipices, with jagged sides and rugged crests, rise one above the other, the wildness of the scene increasing as the summit is approached.

But the rocky precipices are climbed or skirted, and we reach a narrow mossy slope that leads upwards to another ridge. A short sharp scramble upon the very crest of this

ridge, now leaping from rock to rock, then climbing an awkward crag, anon sinking ankle deep in the soft yielding bog moss in a small hollow, and at last we stand upon the broken masses of schist with which the cairn has been built up. The cairn has been reached at last: now we can rest and enjoy the charms of solitude.

The west wind rolls up from the Atlantic yonder, and as it ascends the mountain, banks of mist are formed which are hurried over the summit to be carried down and dissipated on the other side. Never before have clouds appeared to travel so fast. For a few minutes we are flooded with golden sunlight; dropping points of light extend from the edge of yonder disappearing bank of mist; then a sudden chill is felt, the sun disappears, and again we are enveloped, and can see but a few feet around us. Then comes a longer break. The sun shines brilliantly once more, and we get a clear view on all sides.

What a revelation of the power of sight does the view from this height give us! To the north, peak after peak rises up, one beyond the other, until the eye loses them in the distance, a veritable sea of summits stretching as far as the eye can reach. To the east, a shoulder in the opposite hill reveals a small portion of Loch Long, beyond which Ben Lomond, with his three-terraced peak, rises without compeer, whilst far, far beyond, another gleaming patch of water can be seen high up among the mountains, whilst silvery gleams, glistening among the dark pine-woods which dot the landscape far away, indicate the situation of other lovely lochs. To the south is the lower part of Loch Long, opening into the Firth of Clyde, whilst to the west Loch Fyne comes into view here and there between the mountain

peaks; and far beyond the farthest summit, extending like a golden line along the horizon, is the Atlantic Ocean.

But again a chilly feeling creeps over us; the beautiful panorama is blotted out, the sun disappears, the brilliant scene is gone, and we are alone, utterly alone, upon the mountain. Soon, however, the cloud of mist passes, and we are once more standing in the warm sunshine, whilst the mist rolls beneath and reflects the brilliant light, until at last it thins out and disappears, leaving not a wrack behind. Very fine indeed is this new experience; but we have been here long enough, it is time to begin our homeward journey.

Having skirted the western and northern, and climbed the eastern ridge of this rocky mass on our ascent, we determine to descend by its south-eastern face. This is steep, and for a short distance rocky; but the rocks soon give way to grass, and as the ground on this side is as yet firm and solid, our descent is rapid. But this rapid descent is not an unmixed blessing, for occasionally a little rill extends itself upon the rocky surface, and before a stoppage can be effected on the border of a piece of treacherous bog the oozing water has come over our boots. A narrow streamlet, with icy cold water rapidly running over the steep descent, has to be crossed, and immense blocks of rocks, some of which must weigh many tons, begin to encumber the ground. We look around. Yes, there can be no doubt that they have fallen from the rocky precipices near the summit; but that must have been a long time ago, for we observe that they have undergone a considerable amount of weathering. On one of these blocks we stand, and about five hundred feet below see a burn, shining like a narrow belt of silver in the sunlight, whilst its banks a short way down are clothed with little trees.

"Down by yon burn, where scented birks
Wi' dew are hanging clear"—

we can rest awhile in the shade, and for a time defy the scorching sun. Not that the birches will be hanging with the early dew of morning this lovely afternoon, but instead thereof their pendent leafy boughs will be bathed in the drops of spray that rise as the racing torrent dashes madly over the rocky boulders in its bed.

As we stand on this rock in the bright sunlight, we see that we have long since left that narrow stratum of the atmosphere near the summit, where the mist was being formed, and through which it drifted so rapidly. There is a mass of mist enveloping the summit now, but it soon disappears, and there is nothing to indicate these rapidly formed and as rapidly dissipated misty masses, through which we have just passed, except an occasional white cap to the summit, and a thick haze far around it.

The burn which we see below runs down the bottom of the valley that separates Ben Donich from The Brack and Choc Coinnich, and almost opposite to us, looking southward, is another valley, separating the latter from Tom nan Gamhna. What a contrast the two mountains present; the former with a broken rocky summit, and its lower slopes covered with grass or beds of bracken, among which large masses of rock stand out gaunt and bare; the latter gently sloping to the waters of the distant loch, its rounded summit one living brilliant waste of purple heather. Yet not quite a waste, for does not the poet sing—

"Flower of the waste, the heath-fowl shuns
For thee the brake and tangled wood,

To thy protecting shade she runs,
Thy tender buds supply her food,
Her young forsake her downy plumes
To rest upon thy opening blooms."

Truly Tom nan Gamhna is very beautiful, as seen from here, with its lovely heather cap and sides. We look round, and there, to our right, far, far below us, is the beautiful Loch Goil, sparkling like gold in the bright afternoon sunshine, except where a long black line crosses it from side to side. What is that black line? Ah! there is the culprit, one of those dreadful steamers which are allowed to pollute the otherwise pure atmosphere of this lovely place. Only two or three times a day do they come up the Loch, but that is sufficient to leave a dirty black margin of soot, some two feet wide, on the margin of the Loch, every time the tide falls, and to cover the thrift on its banks with filth. But this is nothing to the condition of the firth lower down, where some of the most beautiful scenery is occasionally (nay, constantly) hung as with a funeral pall. How long elsewhere would a comparatively few steamers be allowed to produce this condition of things? Why is it tolerated here?

But the sight of that steamer reminds me of the ability with which the fleecing of tourists is carried on in these parts. There appears to be no fixed tariff from pier to pier; the man who distributes the tickets charges what he thinks you can afford to pay, and it would seem as if he were selected for this post on account of his aptitude in smelling out a stranger at once. Tired after a night's journey, a bit untidy and a little unwashed, a shilling was the amount I had to pay from Gourock to Lochgoilhead with half-price for a boy of twelve. A few days after, the journey from Lochgoil-

head to Coulport (about half the previous distance) was successfully carried out for the same fare, but the return from Coulport to Lochgoilhead, later in the same day, cost one shilling and sixpence each. This had become interesting, and I began to feel anxious whether, if we did much riding on the steamers, and if this variable but progressive increase lasted, we should be able to get home again. However the steamer was not used by us again until we took our final leave. This time it was an excursion boat from Glasgow that we boarded. Everywhere we read "Return fare—one shilling (saloon), ninepence (steerage)." There was hardly room to stand. Glasgow was much farther on than our destination, and we were only going in one direction; so we were evidently in for a cheap ride.

An intelligent Scotchman appeared with tickets. "How much for two adults and a boy?" I ask. "Four shillings and sixpence; we don't give half tickets to boys." I asked the man who settled the fares. "I do," he said, and undoubtedly he did to his own satisfaction, for the tickets were not checked, and the man who gave them out collected them. The way we were treated showed the canniness of the business.

Starting off again we are soon on the level of the top ridge of the heather-clad slope. Be careful there! Ah! it is too late. A sudden slip and my right hand is doubled under me, and my wrist and one of my fingers are—well, perhaps not broken. Let me try the helpless member! Don't mind if I yell out. I don't know how it affects you, but a real genuine scream does relieve my feelings sometimes, and, as there are only you good people here to be disturbed, I'm going to yell now. Backward and forward—yell, yell; backward and forward

the finger goes, and one of my companions comes back. He looks at it professionally and at me contemptuously, saying: "Put it in the cold water there," and away he goes. He was right; the finger wasn't broken, nor the wrist, and as I did not feel the result of the fall for more than three months after the mischief was done, I suppose I deserved the professional contempt. Pulling myself together and using a little more circumspection over the next bit of the descent, I soon join my companions, who are sitting on one of the large rounded blocks which strew the bottom of the burn, from which we are soon drinking our fill, and laving our hands in its sparkling water.

There is the big Ben towering high above us, quite free from cloud now, as indeed are all the mountains round. The mist has passed away, not a cloud appears in the bright blue above. My companions are terribly fidgety, and presently one of them sprinkles his face with water. Then a tingling, creeping sensation takes possession of my neck, cheeks, hands, in short, of every exposed portion of my body, and my nostrils and eyes itch abominably. Rubbing only makes matters worse. As I look at them I see that my companions are covered with countless numbers of tiny midges, which swarm on the surface of this mountain burn. Millions of little atoms there are crawling into our eyes, ears and nostrils. We bathe our faces in the water, and very quickly get on the move.

For a short distance we go down the bed of the burn, springing from rock to rock. What a lesson do these rounded, rocky masses teach us! Here and there, scattered over the mountain side, we have seen large masses, sometimes collected in a group, at other times lying isolated and

separated, their rude angular edges curved and moulded by the hands of the wonderful workman—Father Time. But the masses which thickly strew the bed of the stream are generally smaller. The power exerted by the clear sparkling water of the burn in its incessant onward motion is manifested in the smooth rounded character of these rocks. Silently but unceasingly its work is carried on, and with increased force when the burn is swollen by heavy rain or by the melting snow in early spring. At such times its force is irresistible. The soft loose earth is quickly worn away at the base of the narrow cañons through which the burn has cut its way, and through which it then races madly along, and the next frost is often sufficient to bring the superincumbent mass tumbling headlong into the stream. Then the work of disintegration begins; the loose mud is washed away at once, the small stones are hurled against each other by the foaming, gurgling water, and their rough edges worn off, whilst the larger masses are embedded in the floor over which the rapid torrent passes, and round them the water now eddies in ceaseless murmurings, then rushes with headlong fury, hurling smaller pebbles against them with tremendous force; but alike in its season of gentleness and in that of madness, it is constantly wearing away the rough, sharp processes which oppose its progress, until by-and-by smooth rounded rocks like these on which we rest are formed.

How remarkable too does such a stream as this appear! The faint breeze scarcely causes the aspen to rustle or the birches to nod their topmost, arching, slender boughs, whilst the murmuring of the water makes sweetest music in our ears. The water hurries and bustles past, yet it is still there;

the same spray appears to dash over the trailing branches, the same eddy gurgles round and round the hollow at our feet, the same foam floats silently over the broken rocks. Ever passing yet ever present is the water of this mountain burn as it breaks over its rocky bed, here in a short, steep rapid, there in a miniature waterfall, yonder resting seemingly in a silent pool, there babbling over the rocks again, hidden beyond that massive block of schist, sparkling like gold again as it rounds the mighty boulder. Ah! how true it is that—

"Nature in every form inspires delight"—

if we will only open our minds to her teaching.

The stream is lined with birch trees, which hang over the water, whilst a steep bank rises on either side. On the Donich bank the bracken waves its luxuriant, fan-like fronds, whilst on the opposite side the beautiful waxen-looking flowers of the "bell-heath" form a lovely margin to the steep bank which leads up to the waving plain of purple-tinted hue that rises to the summit of Tom nan Gamhna. Up the bank we climb, and as we face the valley between the latter hill and its mightier neighbour, acres upon acres of heather stretch before us. From here it looks, in the afternoon sunlight, like a vast sheet of rosy purple fading away in the distance, because the eye can no longer trace it. As we stand admiring the brightly coloured scene, the lines recur to us—

"And this gay ling, with all its purple flowers,
A man at leisure might admire for hours:
And then how fine this herbage! Man may say
A heath is barren, nothing is so gay."

A great deal of confusion exists in the use of the term heather, which is frequently applied to several different

plants. This great rolling mass of blossom, formed of heads of dense, closely packed flowers with tiny corollas divided into five separate petals, whose tangled, matted stems form an almost impassable thicket from three to four feet in height, is the common ling (*Calluna vulgaris*), and it is to this plant that the term "heather" is generally applied. But this beautiful flower on the edge of the bank up which we have just climbed, with its larger, lovely, waxen-looking pink flowers, collected in a little cluster at the very top of the stem, is an entirely different-looking plant, although a true heath, and sometimes called heather. This is the "bell heath" (*Erica tetralix*); the scientific name is derived from "tetra," meaning "four," the leaves being arranged in whorls of this number. There, by its side, is another heath with similar urn-shaped, hollow flowers, but this does not form a head at the top of the stem; the flowers, which are of a rich rosy-purple tint, being arranged in whorls or rings along the branches. This is called *Erica cinerea*, the specific name meaning "ash coloured," and being given on account of the general tint of the plant as a whole. These two latter plants, although much alike in some ways, differ greatly in others, and both are very different from the tall, woody, open-flowered, purple ling, whose branches are covered with an abundance of tiny blossoms. This last, which is so abundant here, reminds us of the couplet—

> "If heather bells were corn of the best,
> Then Buccleuch would have a noble grist."

Beautiful as are the flowers of all the heaths, I must own that my fancy makes me favour the lovely "bellheath." Pick that flower at your feet and examine one of its blossoms. It is somewhat like a hollow urn, the stigma filling up the

entrance to the open top. Round the style (that upright part of the pistil which supports the stigma) the five anthers are placed side by side, forming a circle or ring around it. You notice that the stigma protrudes beyond the stamens, and thus self-fertilisation is rendered impossible. The anthers being placed so closely together, the pollen, even when ripe, cannot fall out; but on the outside of each anther are two little spiny processes, which, when pressed with a pin, force the anther away from the style and from its companion anthers, and this allows the pollen to be freely scattered. How, then, does Nature set the pollen free? Easily enough. The bottom of the tubular corolla is provided with nectaries in which nectar is secreted; a bee comes to the flower to rifle it of this nectar. Into the corolla the tongue of the bee is thrust, and its head is forced into the upper part of the hollow as well; the head presses against the spiny processes of the anther, which is thus forced back, and the pollen is scattered over the bee's head as it sucks the honey from the nectaries below. Having rifled the flower of its contents, the bee flies off to another; its head comes in contact with the sticky stigma thereof, to which some of the pollen grains adhere. As it passes from flower to flower the same process is gone through, the same unconscious work is performed in obedience to the behests of the Great Mother, who thus utilises one of the humblest of her offspring for the common weal.

What a number of bees there are flying about! I expect that some one has brought his hives up here. I know that in many parts of England and Scotland bee-keepers place their hives on the edge of the heather-clad moors during the summer, at that time when—

"The tiny heath-flowers now begin to blow;
The russet moor assumes a richer glow;
The powdery bells that glance in purple bloom,
Fling from their scented cups a sweet perfume;
While from their cells, still moist with morning dew,
The wandering wild bee sips the honied glue;
In wider circle wakes the liquid hum,
And far remote the mingled murmurs come."

The quantity of honey gathered by bees from the moors in the late summer and early autumn is scarcely credible. I have seen it asserted that bees will then collect in four or five weeks as much as they ordinarily collect during the remainder of the year.

But the heather is not always allowed to become the tangled mass we see it here; it takes many years to reach a growth like this. As we descend we come across a bright green patch of young heather. Where deer and grouse are kept this young heather is very valuable. No doubt a fire has accidentally occurred here, which has burnt off the old ling, and this young heather has taken its place, although generally, when a fire occurs among old heather, it almost exterminates the plant. Strange to say, if burnt regularly when young, it produces a delicate green carpet, which is much prized. The reason for the extermination of the old heather is not far to seek; the woody underground rhizomes after a time fail to send up the strong leafy shoots which they produce abundantly when young, and hence, when the leaf-producing branches at the top of the plant are burned, it dies off completely.

Where young heather is required the burning takes place regularly in the early spring, and this practice is very common in many parts of Scotland. It is an exciting business

for the gillies who have to keep the fire within bounds, for it spreads with amazing rapidity, and by night the long streams of flame and thick clouds of dense smoke rolling along the mountain sides, now threatening to engulf almost everything in ruin, anon being subdued by the vigilant watchers, produce a remarkably weird and striking effect.

The rapidity with which these fires spread has been graphically pictured by Scott, who compares the speed of Donald, the bearer of the fiery cross, to the "muirburn" when he sings—

> "Not faster o'er thy heathery braes
> Balquither, speeds the midnight blaze"—

whilst the grandeur of the spectacle is equally well depicted in the oft-quoted lines—

> "How grand the scene yon russet down displays,
> Whilst far the withering heaths with moorburn blaze;
> The pillared smoke ascends with ashen gleam;
> Aloft in air the arching flashes stream;
> With rusty, crackling noise the flames aspire,
> And roll one deluge of devouring fire;
> The timid flocks shrink from the smoking heat,
> Their pasture leave and in confusion bleat,
> With curious look, the foaming billows scan,
> As whirling gales the red combustion fan."

Is the heather useful, do you ask? Do you not remember what Ellen told Fitz James?

> "Before the heath had lost its dew
> This morn, a couch was pulled for you
> On yonder mountain's purple head."

Really this pleasant green carpet, with its delicate pink haze, looks exceedingly tempting, and yielding to its fascination we slowly settle ourselves down to recline on it.

As we do so we are once more reminded of those giants of Scottish song, who thoroughly appreciated the comfort of such a resting place, and who taught us that as an indoor luxury it need not be despised ; for does not Scott tell us again—

> "The stranger's bed
> Was there of mountain heather spread ?"

whilst the bonniest and cheeriest of them all, Burns, sings of the feeling of comfort derived from sleeping—

> "Upon a heather bed
> Sae cosy and sae canty."

We are cosy and canty enough here certainly, out of reach of those terrible midges that, like mocking demons, haunt the burn side this glorious afternoon. As we lie and ponder, we recognise how little we really know, and, in the presence of even so simple a flower as the heather, feel inclined to cry out in our ignorance—

> "Flower in the crannied wall,
> I pluck you out of the crannies!
> Hold you here, root and all, in my hand,
> Little flower ; but if I could understand
> What you are, root and all, and all in all,
> I should know what God and man is."

We lazily stretch our limbs again, and climbing down the bank, find ourselves in a beautifully wooded dingle, with here graceful birches, there a mountain ash, whilst yonder, clinging to the rocks, where there seems scarcely sufficient room to give it root-hold, is an aspen, its leaves quivering in the faint and fitful breeze, and explaining fully the poet's simile—

> "Varying as the changeful shade
> By the light quivering aspen made."

The mountain ash is *par excellence* a Scottish tree, beautifying the woodlands, adding charm and grace to many a wild mountain torrent, and clothing bare and rugged spots

FIG. 19.—MOUNTAIN ASH (*Pyrus aucuparia*).

a, Leaves and blossom. *b*, Flower. *c*, Flower enlarged to show stamens. *d*, Pistil. *e*, Berries. *f*, Longitudinal section of berry. *g*, Transverse section of berry.

with unexpected greenery. Known in Scotland as the rowan tree, the mountain ash is quite remarkable for the wealth of weird romance which surrounds it. In the wildest glens the ignorant country folk still believe in its efficacy

against witches, whilst others prove its ability to drive dull care away by manufacturing beer from its berries. The superstition attached to it probably had its origin in Druidical times, and in some parts of Scotland, at least till very recently, a hoop of rowan wood was made, through which the sheep were made to pass morning and evening in order to preserve them from harm.

How lovely are its bright red berries in the winter! How exquisite its pretty white flowers in early spring! How charming its delicate scent! How graceful its frond-like leaves in summer and autumn! Truly with Wordsworth we may say—

> "The mountain ash
> No eye can overlook, when 'mid a grove
> Of yet unfaded trees she lifts her head,
> Decked with autumnal berries that outshine
> Spring's richest blossoms."

Here it rears its head in company with the birches, high above the little thickets of tangled brier and thorn, often indeed overtopping its graceful neighbour. It must not be forgotten that the mountain ash has no affinity with our "queen of the woods," the common ash tree; its connection with our fruit trees is shown by its blossom, its fruit, and perhaps by the manufacture of rowan jelly from its berries. These contain a peculiar sugar, called sorbinose, which, although hard and gritty, is quite as sweet as cane sugar.

The banks of the burn now form steep and high rocky walls, whilst the burn itself flows noisily on at the bottom of the wild bed which it has cut out for itself. But the bed soon widens out a little, and in every sheltered corner a birch tree has taken up its position; the graceful trees line the stream, here and there leaning over, as if to dip their boughs

into the spray that it throws up, as it dashes over a larger rock than usual which lies in its bed and tries to bar its progress. The water is merry yet, noisy as a child at play; but the bed widens out, the steep banks fall back on the Donich side. A large clump of birches, looking, if possible, more beautiful than those we have just seen, rises from a little island in the centre of the bed; the burn suddenly divides, to flow round the island, and passes out of sight on either side before we can see whether the branches join again lower down.

A sudden descent bars our way. We must go back a little and make a *détour;* as we do so, we find ourselves on a little heathery knoll rising out of a sea of bracken, which attains a height almost as great as our own, whilst the tops of the birches by the burn below are now only a few feet above us. This knoll is a very enticing spot in our present mood, and we gladly seize the opportunity to linger awhile, and soon our minds are concentrated on the birch trees here.

The oak has been well termed the "monarch of the woods," the ash, the "queen of the woods," but the birch—

> "Most beautiful of forest trees,
> The lady of the woods—"

and, with its upright trunk of silvery whiteness, its pendent boughs and drooping twigs, its tiny leaves, through which the sunlight shimmers and falls in dancing rays upon the ground, it well deserves the title. Beautiful as is the birch in its woodland haunts, it is when it rises tall and erect from some sheltered nook by the side of a mountain burn, with its overhanging branches and green leaves sprinkled and bedewed by the foaming spray, when (as Burns writes)—

> "The braes ascend like lofty wa's,
> The foaming stream deep roaring fa's,
> O'erhung wi' fragrant spreading shaws.
> The hoary cliffs are crown'd wi' flowers,
> White o'er the linns the burnie pours,
> And rising, weets wi' misty showers"—

then, as a graceful setting to such a mountain scene, the birch is seen at its best, and stands out in elegance and fairy lightness far beyond the companions of its lovely solitude. By this burn, in every cranny, the birch has found a home; there, in yon exposed spot, is one twisted and gnarled by the gusts that sweep down the glen in winter; here, in this nook, sheltered between those high rocky cliffs, is another, tall and stately; up yonder we see—

> "Hung high in air the birch in tassell'd pride,
> Clasping with tangled roots the rock's grey side"—

while on yonder flat, straight and erect, with spreading branches, is a splendid tree which has taken full advantage of its better position, as is shown by its sixty feet of height, and which quite equals the finest examples of our "lady of the woods," to be found in its more southern haunts.

There is a nest in yon birch tree, you say. No, it is not a nest! Climb into the tree, and you will see what it is. There has been a stoppage in the growth in length of the branch, caused by some injury probably inflicted by an *Acarus* long ago, and a large knot has been formed there. This has given origin to a vast number of small twigs, which, spreading in a horizontal direction and interlacing as they spread, have given rise to the peculiar nest-like appearance.

Yonder is an old birch that has evidently seen its best days. On its decaying trunk is a massive flattened disc of a somewhat pale brownish colour, quite a foot in diameter

and some four or five inches in thickness, which proves to be a parasitical fungus, called *Polyporus*. This has obtained its nourishment from the decaying tissues of the tree. In texture it is elastic and cork-like, and inside its colour is of a beautiful pure white; indeed, so white and so firm is it that it is frequently used for the purpose of cutting small models, but it has not yet been put to any other useful service.

Should we not give the birch a good word for its robustness and hardihood? Not only does it add beauty and grace to many a rugged scene on our highest British mountains, but high up in Alpine solitudes, beyond the farthest limits of the oak and fir, and in the far North, where arctic snows and bitter cold hold sway during a great part of the year, the birch redeems many acres of iron-bound land from the curse of absolute and utter barrenness. Does it not deserve a good word, too, for the moral effect which it has undoubtedly had on successive generations of boys and youths? Has it not been styled—

> "Afflictive birch,
> Curse of unlettered, idle youth"?

Long may the lovely birch and its richly scented companion, the hawthorn, remain to beautify our highland landscapes! Long may we hear—

> "How sweetly bloomed the gay green birk!
> How rich the hawthorn's blossom!"

Here is a footpath used by the shepherds; notice how it winds in and out as it passes through the brakes. We follow it, knowing that its course, though tortuous, is the only safe one; soon we are descending very rapidly, slipping, sliding and clinging, then to a tough bracken stem, now to a mass of heather, to steady our downward career. A few moments of this rough-and-ready method of travelling suffice to bring us

to a level spot; but our burn is nowhere in sight, although we can hear it distinctly enough. A tall rugged rock lies to the right of us; a few steps farther, and we pass round the mass and stand on a little knoll, and there, right before us, is the burn again.

The beautiful scene flashes on us like a revelation. Above are the lovely birch trees on the island where the burn divides, whilst on both sides tall precipitous rocks, black and bare, hem it in. Their ruggedness is softened by the graceful beauty of the birch trees which rise from their bases, whilst the slender weeping branches and tiny leaves relieve the nakedness and blackness of the rock itself. Above the perpendicular cliffs the rocks on the Donich side are in large broken masses, while the weathering of ages has formed a deep surface soil here and there, in which a sturdy-looking thorn or graceful mountain ash has taken its stand, the rock ledges themselves being narrowly lined with blossoming heather; the topmost ridge of broken rocks leads gradually to the grassy slopes of the mountain above.

With such a background, the divided stream comes rushing on, one branch sweeping round each side of the tiny verdant islet in its centre; the two join again beyond the island on a large hollowed ledge of rock, the water eddying and bubbling as the streamlets rush into each other, and the reunited stream flows foaming onwards down the smooth rocky bed until the edge of the precipice is reached, when, with a bound, it dashes over into the abyss below, scattering the spray in clouds, whilst—

> "The monstrous ledges slope and spill
> Their thousand wreaths of dangling water-smoke,
> That like a broken purpose waste in air."

The water falls into a huge basin, worn by its ceaseless action through many ages, from which it pursues its rapid course down a rough, rock-strewn bed again, on either side of which the black rocks, dark and sombre, rise precipitously. On the left bank of the burn they soon cease, and slope down to the little knoll on which we stand; but on the right bank they fall back, a tangled mass of undergrowth at their base forming an almost impassable thicket, above which birch trees and mountain ash still rear their graceful heads and still temper the sternness of the rocks beyond. Then they suddenly close in again, and just below us the burn enters another rock-strewn cañon, on its way to the foot of the mountain.

Truly the whole scene is very beautiful in its wild grandeur, its beauty heightened by the foaming, bubbling cataract into which the sudden fall and steep descent have changed the playful burn. The water rushes over its rocky bed, thundering in its course, down this wild bracken-covered ravine, and to our thoughts pictures of the long, long ago present themselves, which were not even suggested by the ruggedness and grandeur of the mountain summit.

How vividly does the naturalist instinct rise up within us here! How decidedly is all that is best in us brought uppermost in our minds as we stand on this altar step of Nature! What pleasure we feel, in spite of our ignorance of even the meanest things around us! And as we think of the grasping, striving world, where such pleasure is unknown, we feel the truth of the poet's words—

> "All Nature is but art, unknown to thee!
> All chance, direction, which thou canst not see!
> All discord, harmony not understood,

> All partial evil, universal good:
> And spite of pride in erring reason's spite,
> One truth is clear, 'Whatever is, is right.'"

The rocks, the cañon, the bed of the burn, all unite to form a weird picture in the mind. But the bracken has a very strong flavour of these old, old times about it, too. Ferns carry us back in thought to the time when the land first began to emerge from the primæval waste of waters, and to assume shape and substance; for it is more than probable that the first plant that inhabited the dry land was not unlike the simplest of our ferns. Until then marine algæ had held the premier place, and had had no compeers, obtaining their food from that waste of water in which they lived and flourished; but when land plants came into existence, there can be little doubt that they bore some remote resemblance to our ferns of to-day. This is not so speculative an idea as it may at first sight appear to be, for down in the depths of the earth the story is written, and the records have been occasionally discovered, and we have learned how imprints of their delicate fronds, or fossilized remnants of their characteristic and well-known stems, have been found buried in these old, old rocks, and have been exposed to the light of day, teaching us that even then they flourished in this world of ours.

Few, comparatively, the remnants undoubtedly are which are brought to the surface, and only few of these are seen by scientific men, but these few have been more than sufficient to teach us wide-reaching lessons; and if we consider how frail and fragile these delicate plants frequently are, how vast is the superimposed mass which has been deposited on them, and how immense the pressure to which

they have been subjected, we may well wonder that any remnants at all have been left to bear witness of these bygone ages.

In the carboniferous system we find evidences in great abundance of the existence of ferns and of plants allied to them at the time these rocks were being formed; in fact, there is little doubt that our coal measures are composed entirely of plants of this kind, which reached their maximum in point of development at the time these measures came into being. As we proceed onward in the history of the formation of the crust of the earth, we find that ferns are succeeded by pines and firs, and these, in turn, give place to flowering plants. Botanically, pines and firs are more complex than ferns and mosses, but are surpassed in complexity by the flowering plants which show a distinct structural advance on either of the previous groups.

Here, then, the fossils teach us Nature's work in the long ago, and show us how complete is the gradual advance from the simplest to the most complex forms; and nowhere is this advance shown so completely as in the development of the flowers or reproductive organs.

Let us see how the fern is reproduced. On the fronds, in varying positions, and at different seasons of the year depending on the species of the plant, are found small brown masses. Here, on the bracken, we see them forming on the under surface of the fronds; in other ferns we find that they sometimes form rims to the fronds, sometimes lines, at other times rings on their under surfaces. These brown masses are composed of a number of minute cells, each of which is called a spore. When the spores fall to the ground they germinate, but, instead of immediately pro-

ducing another fern-plant, each spore gives rise to a little heart-shaped, leaf-like structure, called a prothallium. On this grow two distinct kinds of minute bodies, one of which contains a germ cell with a canal leading to it, the other gives off, when mature, little ciliated cells, some of which make their way through the canal into the germ cell, and

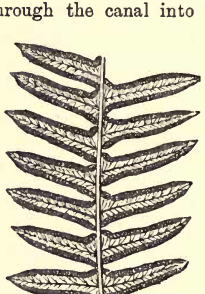


FIG. 20.—PART OF MATURE FROND OF BRACKEN (*Pteris aquilina*). Underside showing Sporangia.

fertilise it. From the fertilised germ-cell a true fern is developed. Thus we get fern, prothallium—fern, prothallium, etc. It will be seen that only the alternate generations resemble each other, and from this circumstance the process has been designated the "alternation of generations"; this was once pithily defined by an eminent naturalist as a process in which each individual is exactly like its grandmother, but bears no resemblance to its mother.

We have called the leaf-like parts of the fern fronds, and very beautiful some of them are, but they must not be confounded with leaves; they are really leaves and flowers

combined, or at least discharge the double function. They are developed very differently, too, from true leaves. You see that the tip of this young bracken frond is folded round and round, and the base of the frond unfolds and develops before the apex. Now, in true leaves, the apex of the leaf unfolds first, and development takes place from the apex towards the base. It is evident, therefore, that the frond is not a leaf.

In parts of New Zealand and Australia, ferns grow to the height of trees, and sometimes have a trunk forty or fifty feet in height, surrounded with a crown of feathery fronds. What! we have reached the Antipodes in our day-dreaming, and with this beautiful scene before us. We step into the bed again, and, after going a short distance, stand on a rocky boulder, firmly embedded in it, and gaze back at the beautiful picture of which we can now get a wider view.

But we must not stop. The bed contracts; the rocks rise perpendicularly on either side of us; we make our way over the broken rocks scattered along the bed; the descent becomes deeper; the water whirls and gurgles noisily; and at last we have to leave the bed and climb up to the rough-made path which edges its bank. A break in the rocky bank brings the burn into view again, as it tumbles over another perpendicular rock into a large hollow basin, several feet in depth. From here it starts off once more, the rocky sides sometimes more, sometimes less steep and precipitous, and there, far below, we can see that its bed gets wider, shrubs get more numerous but trees rather fewer in number, until at last we see the burn emerging from its rocky prison house, and in its wider bed we know that it gurgles musically over the rocks and pebbles, whilst still farther on

we see the trees, and quite in the distance, the little bridge on which we stood in the early morning. You cannot see the bridge? Well, never mind, perhaps it is only fancy that makes me believe that I can; we know it is there though, and that will do as well.

We keep near the burn, and tap the birch trunks as we pass. From yonder tree flies our Carpet moth again. Most of those we see here are of a whitish colour, with a pale slaty hue, and with a few wavy lines running transversely across the wings. Observe how well their colour harmonises with the pale silvery bark of the birch! There is a dark one very conspicuous on the trunk of this tree, but we readily understand that as some of the moths rest on the dark rocks as well, Nature protects some dark ones every year, and with two such strongly opposed conditions working side by side, there will be a distinct tendency to produce two different forms. The search by the birds on the birch trunks alone would lead to the extermination of the dark forms and the preservation of the pale ones, whilst on the other hand, the search on the dark rocks must result in the extermination of the pale forms and the preservation of the dark. Hence, either of these conditions by itself would tend to produce a dark race on the dark rocks or a pale race on the birch trunks, whilst by their united action, dark and pale forms are produced side by side, and the variation of this moth is maintained. The predominance of the pale specimen here shows, however, that the habit of the carpet moth on the banks of this rolling burn is to rest on the birch trunks in preference to the rocks.

We are still some eight hundred feet above the loch, and now we leave the burn, and climb the sloping side of Tom

nan Gamhna, at one time wading waist-deep through the heather, at another, tramping over the springy *Potentilla*-carpeted turf, until at last we reach a narrow pathway, which leads to the village below. This pathway is rocky and steep, here crossed by a marshy rill, there descending rapidly into a hollow leading to a tiring climb up the opposite side. Our feet often wander. Here we watch the clouds of little TORTRIX moths flying over the heather, there we see a rich red-brown "plume" moth, with long spiny legs, sipping the nectar that the bees love. Then the rapid-flying grass moth, called the Antler on account of the strongly-pectinated antennæ of the males, is seen scattering its eggs far and near, whilst a newly emerged female moth attracts her lovers in shoals. Quite amusing is the flight of these gentlemen moths who are seeking the lady's favour, but her choice is soon made, and in a few minutes the rejected suitors have disappeared from view.

From the large scattered boulders moths fly off as we approach, and these we inspect carefully. All are of the same blackish hue, all have the wings covered with paler transverse lines; thus they assimilate, not only to the dark coloration of the rocks, but also to the wavy pattern with which the rock is marked. These moths are of many different kinds, although all have the same general habit, and we are sure that the Great Mother has been at work, and that this resemblance is the result of a long, long period of selection carried on by her.

The sun has now sunk to rest beyond the mountains. Everything seems still and silent, but for the far-off bleat of a sheep or the whistle of the plover. No, as we pause for a moment, we can hear a steady hum that tells of insects'

wings in rapid vibration, and a thrilling murmur of the bubbling burn reaches our ears. Numbers of different sounds there are all round us, now that we stay to listen for them, and the air spirits would fan us dreamily to sleep. Well, sleep up here would be pleasant enough, I dare say, but we have had a long day and—yes—perhaps bed is preferable to us who are unused to sleep in the open air.

We come to a rocky wall, made of loose stones, and broken here and there. The path leads under this, and is wet and slippery, and must be trodden with care. The twilight, which has long exceeded the limit it reaches in our southern home, draws rapidly to a close. Quickly the daylight fades, the distant mountains recede farther and farther into the approaching darkness, soon hazy shadows alone are left, and even the objects near us loom indistinctly in the gloom. Yes, night is here at last! Twilight is gone, and we feel thankful, as we pass through a farmyard, that we are clear of the treacherous path. The night moths fly busily from flower to flower sucking honey, or from leaf to leaf to lay their eggs; the now distant burn keeps up a rippling hum on the still night air; the mountains have long since faded from sight; the birds are silent. As we near the loch, thoughts of rest are mingled with happy memories of racing clouds and craggy precipices, of lovely torrents and sparkling cascades, of endless depths of moss and far-spread wastes of blooming flowers, of gnarled thorn and graceful birch, of all the many beauties which Nature has unfolded before us to-day, of all the many lessons which she has taught us.

HILLSIDE.

It is a magnificent morning in July, and I am standing on the highest ridge of the chalk hills, a short distance to the south of Rochester. A cool, refreshing breeze invigorates me; the clear azure of the sky above is unsullied by a single speck, though on the horizon, to the south-west, a large mass of cumulus, sure presage of a blazing noontide, sails majestically along. Dewdrops still hang here and there from the grass and clover, sparkling with the brilliance of diamonds; but these soon vanish at the bidding of the early morning sun.

The climb up the rough and steep road, necessary to reach my present coign of vantage, has made me breathless, and while I rest for a few minutes on this dark green carpet of clover which stretches far away into the distance, a hazy red, clearly discernible like a fine film on its surface, telling that the time of blossoming is not far off, I will invite my readers to gaze with me on the panorama which lies unfolded before my eyes.

In front of us, in the direction of the road by which I have come, is a fertile valley; in one part the yellowing corn is ripening under the genial influence of the sun; in another, dark rough-leaved hops stretch from pole to pole, and at last throw their spiral necks far above into the air,

as if revelling in their freedom; presently, one slender head stretching towards another curls its ever tightening stem round and round it, the twain rearing upwards like snakes

FIG. 21.—HOP-PLANT (*Humulus lupulus*).

a, Hop plant bearing male flowers. *b*, Hop plant bearing female flowers. *c*, Hop plant bearing ripening catkins. *d*, Staminate (male) flower. *e*, Catkin of pistillate (female) flowers. *f*, Pistillate flower. *g*, Fruit. *h*, Section of fruit and seed.

in deadly combat, each winding its folds about the other, until, overcome by their own weight, they fall downwards and stretch outwards, ready to scratch and tear the skin of the unsuspecting individual who endeavours to force his

way through them. There, a field shows the dark, vivid hue of mangolds; yonder, another displays the brighter green of swedes. In the distance is a parched-looking field, probably of potatoes heavily attacked by disease, whilst an emerald pasture, with kine lazily feeding in it, gives variety to the scene. Through the bottom of the valley flows the broad Medway, slowly wending its way to the Thames.

Slightly to the left, and on the other side of the river, the ivy-clad keep of Rochester Castle rears its stately head in rugged grandeur, recalling Saxon and Norman strife, whilst by its side, fit emblem of those more peaceful times when swords shall be beaten into ploughshares, and fratricidal wars shall be no more, is the peaceful-looking cathedral; the two stately neighbours, so different in their grandeur, awaken in the mind thoughts reaching far back into the past, still further onward into the future.

To our right, the gently undulating hills, cultivated to their very summits, bear heavy crops of grain, the deepening colour of which betokens the near advent of harvest. Here and there a scattered hamlet may be espied, whilst an occasional pleasant-looking, well-kept farmhouse dots the landscape, the whole presenting such a scene of pastoral loveliness that we are reminded almost instinctively that we are in the beautiful and fertile county of Kent, "the garden of England."

To our left the chalk hills still rise; windmills in plenty are scattered along their crests; some are embosomed in trees, while clean white cottages peeping through the foliage add interest to the scene; others stand out alone, bare and gaunt, with their skeleton arms extended to, I had almost said, the four winds of heaven, and can only by a great

stretch of the imagination be considered as in the slightest degree picturesque. The smoke rises densely from the river, where lies the thriving and rising town of Strood, joined by a stone bridge, which we see yonder spanning the river, to its more ancient and less active neighbour. Only a few years ago a single street, surrounded by marshes, represented the Strood that Dickens knew; now the marshes have been drained, and a large town has been built on the ague-haunted spot, not altogether healthy yet, however, as an occasional outbreak of disease testifies.

These hills run east and west, and form part of the great chalk range known as the North Downs. Roughly speaking, there are three somewhat parallel ridges; into the valleys between them the clay and sands which cap the chalk have been washed, forming excellent beds of brick earth, which, as we see, is being worked in the hollows. The most northerly of these ridges slopes towards the Thames, and at the base of the slope are the diluvial deposits in which many remains, testifying to man's existence in pre-historic times, have been found.

But to return to the river. From our point of vantage we can trace its course for miles as it makes its way through the range of hills upon which we stand. The range, as I have said, runs east and west, and the river travelling from south to north cuts it almost at right angles. To the right, where it first comes into sight in the distance, lies Maidstone, just hidden by the most southerly of the three ridges; and as it pursues its meandering course, ever widening, ever increasing in bulk, we notice great mud flats at its side; the eye follows it along until, sweeping under Rochester Bridge, it is almost lost in the smoky haze caused by the horrid ex-

halations from the cement factories, to reappear again farther to the north, a glittering line of light in the morning sun, as it flows onwards to meet the Thames at Sheerness.

Did the river really cut its way through these hills until it reached its present level, or did it simply find a natural crack in the rocks through which it took its course? The latter could hardly have been the case, since the rocks are compact and solid enough, whilst the presence of sand and gravel at varying heights proves that the river has flowed at different levels, and has only gradually reached its present position. In the earlier part of its course the river flows over the Wealden clay, and in the gravel beds which occur along its banks in the lower part of its course, we find stones and other materials which have been brought from this upper part. Seeing that the river runs across the line of direction of the hills, we are forced by these facts to come to the conclusion that it must have cut its way through six hundred feet of chalk, gault, and greensand, in order to reach its existing level, and that the vast quantities of material eroded by its action have contributed to the formation of the extensive mud flats now to be found in the tidal areas near its mouth.

This erosion must have been going on for a very long time. How do we know that? you ask. Partly from what we know of the slow action of running water and from a comparison of the power at disposal with the work done; partly, also, because in the old river gravel-beds, to which we have already referred, bones of the elephant and rhinoceros, together with those of many species of animals now extinct, have been discovered; and, finally, because stone implements, which we know were made by a race of human

beings in the far distant past, have also been unearthed from the same beds.

But whilst the river is even now hollowing out and deepening its bed in its upper reaches, the mud which it has been continuously bringing down and depositing near its mouth has for many years been raising the level of its bed in the tidal portion; this gradual upraising is still going on in the lower reaches, whilst the bed gets wider as this takes place. About two or three miles below the bridge yonder, the bed has been raised by mud deposits some fifty feet above its original level, and I could instance many continental rivers where the same action is going on, on a much larger scale.

As we think of the work that the river is at present doing, our minds travel back to the time when it was carving out the higher beds, those in which, as the old gravel terraces teach us, the river used to flow, to the time when the elephant and woolly rhinoceros existed in British forests, when the British Islands were part and parcel of the Continent, and the Medway ran into a Thames that flowed onwards into the river Rhine, whilst the latter river traversed vast alluvial flats, where the North Sea now rolls, and emptied itself into the ocean, probably beyond the most northerly confines of the British Islands of to-day. What changes have taken place since then, even where we now stand! and as we look towards the north, far beyond the point where the Medway enters the Thames, we feel inclined to repeat with the poet—

> "There rolls the deep where grew the tree;
> O earth, what changes hast thou seen!
> There where the long street roars, hath been
> The stillness of the central sea.

> The hills are shadows, and they flow
> From form to form, and nothing stands;
> They melt like mist, the solid lands,
> Like clouds they shape themselves and go"

But we have been prosing long enough about the antecedents of that dear muddy old river—dear to me, because, as a child, I ventured my precious life in an attempt to swim among its dangerous shoals, and received castigation from a loving mother's hands for the daring exploit. Well! we "value that for which we suffer most," 'tis said, perhaps that is why the old river still has such a charm for me.

Now we face the road again. Yonder it winds over the fields without a hedge by its sides, except that formed by masses of bladder campion, the delicate white balloon-like heads of which are apparently swollen to bursting point, of the sturdy pink-blossomed scabious, dark green clumps of ragwort, and an occasional thistle, which the labourer's hoe has not yet exterminated. Here, too, are an abundance of mallows, with their red blossoms and flat fruits, the latter having a tiny sharp spike standing from their centres—"cheeses" the Kentish children call them, whilst the poet writes—

> "Then sitting down, when school was o'er,
> Upon the threshold of the door,
> Picking from mallows, sport to please,
> The crumpled seed we call a cheese."

Quite a flower-garden indeed we find here on either side of the road, forming a boundary quite sufficient to prevent a wandering cart from encroaching on the edges of the fields.

Our gaze extends over the fields. Yonder, the ruddy surface of clover merges into the golden tint of ripening grain;

there, into a darker hue of green, which even at this distance we know must indicate mangolds. Beyond, the shades of green and brown become indistinguishable, but the whole is backed up by a dense background of varied tints, where the woods rise up above the fields to cap the hills towards which we are about to wend our way.

The bright little Copper butterfly, in its brilliant dress, flits from flower to flower, or suns itself, lazily waving its wings to and fro. The Common Blue butterfly and its less brightly hued lady disport themselves pleasantly around. How variable are the females of this active little butterfly!

FIG. 22.—THE SMALL COPPER BUTTERFLY (*Chrysophanus phlæas*).

Some are dull brown, dingily, or at least, soberly clad; others are almost as bright as their lovers. We appear to see comparatively few females, but this is only because they are less conspicuous and less active than their partners. Scarcely any of the blue butterflies which occur in the tropics show a sexual difference; both males and females there are equally blue, but with us, the males are so much the more conspicuous of the two, that a large percentage of them must be captured by birds who prey on them, and hence Nature steps in and protects the less conspicuous form. That this should be the female is to be expected, because on her devolves the duty of egg-laying, and the production of another generation.

We leave the flower-bordered road and follow a narrow footpath over a turnip field. In the field the rooks are busy; they are probably clearing off the caterpillars of some insect pests, and so are doing incalculable good to the farmer. Let us see what it is that they are after. There is a turnip just pulled up, and underneath it are numerous grubs of a dirty-white colour, looking almost exactly like the soil itself. These are the caterpillars of the Turnip moth; they are plump and well fed, but their similarity to the soil will not enable them to escape the keen eye of the rook. In a few days these birds will devour thousands of the grubs, which often exist in such numbers as to constitute a veritable plague.

It is very important to have an accurate knowledge of insect life, for insects may be productive either of good or evil; and if we have not this knowledge, we may destroy the former kind and preserve the latter. For example, lady-birds prey on the aphides which do so much injury to our hops and our fruit, and yet it is no unusual sight to see ignorant labourers destroying them, either with or instead of the aphides which they are paid to exterminate.

The path soon brings us to the edge of a wood, along which it continues for a short distance. The northern ridge of the hills is no longer in sight; the green of the woodside is occasionally tinted with the very earliest reddening berries of the dogwood and bramble, and the harmonious blending of this colour with the different shades of green produces a very charming effect. To our left the field still slopes towards another portion of the wood, wherein are majestic oaks and graceful birches surrounded by a thick and dense under-growth, save where, here and there, a clearing has been

recently made. Between the narrow path and the field is a steep grassy bank, which is beautified by a profusion of summer flowers. Here is the thistle-like knapweed with its bright red flowers, there the pale lilac scabious, yonder a tall branching plant of wild mignonette; at our feet is the blue chicory, and near it a brilliant patch of yellow bird's-foot trefoil, whilst on the more level portions a luxuriant carpet of yellow bed-straw is to be seen. Near the bush yonder we observe the tall spikes of the mullein (*Verbascum*), replaced a little farther on by the bells of the larger blue campanula, whilst the white bed-straw attempts to climb into the bushes, which are scattered here and there, and to overtop its less pushing neighbours. Here, too, are—

> "The thyme, strong scented 'neath one's feet,
> And marjoram so doubly sweet."

We will not go down the bank yet, but will keep under the wood for a while longer! Here is a small clearing in the wood, where the wood sage appears to have made its home. There is a large old yew tree, with its spreading branches, nearly reaching to the ground, thrown over the path, its dense and dark foliage forming a pleasant shade this hot July forenoon. The wood gets more dense and tangled. Masses of clematis and bramble climb from bush to bush, and vie with the wild rose in making an impenetrable thicket through which one may in vain attempt to force a path.

What say you? Shall we rest awhile in this flower-haunted, insect-loving spot? The ceaseless hum of the bee, the beautiful red of the Tortoiseshell, the brilliant tint of the Adonis Blue, and the pale yellow of the female Brimstone butterflies engage our ears and eyes at once. The pug-

nacious Small Heath butterfly attacks its larger relation, the Meadow-brown, while the delicately tinted Chalk-hill Blue and its very dingy brown mate are harassed by the attentions of the nimble Brown Argus butterflies. Hark! There is the merle singing his rich clear notes, whilst ever and anon the sweet whistle of the mavis sounds just behind us; we recognise, too, the soft warbling of the blackcap and the whitethroat, and there is a bullfinch piping in yonder thicket below. Look at the swallows as they circle and eddy above and around us. Past they go like a flash, now wheel-

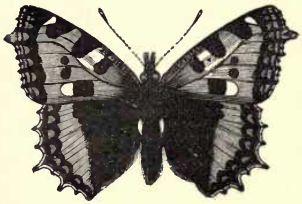


Fig. 23.—The Small Tortoise-Shell Butterfly (*Vanessa urticæ*).

ing high up in the air, then suddenly descending, they skim rapidly along, close to the ground. A Tortoiseshell butterfly that has been hanging like a dead leaf from yonder flower of scabious, lazily rises on the wing to fly to a neighbouring flower. A sudden downward rush and the wings fall at our feet, whilst the body of the butterfly has formed a meal for an ever-hungry swallow. A Chalk-hill Blue flits merrily along, another downward rush, and that, too, disappears suddenly like the other. Now that we are on the look-out for these birds we notice what splendid hawkers they are. But it is the most conspicuous insects that are captured; the

Tortoiseshells are safe until they rise on the wing and display their bright upper sides, owing to the leaf-like appearance they present when at rest. The bright males of the Chalk-hill Blue are taken, their dull, sober-coloured wives more frequently left. Very few of the latter appear

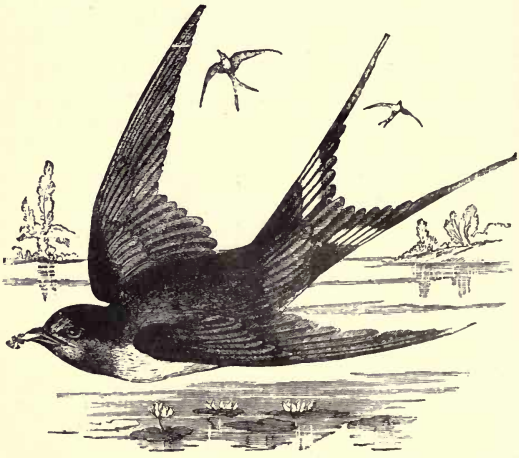


Fig. 24.—The Swallow (*Hirundo rustica*).

to be captured, and we soon understand what a protection their dark coloration must be to that sex, and how skilfully nature provides for the perpetuation of these brightly coloured species, and protects them from utter extermination. A Copper butterfly sits sunning itself on a flower, when a dark shadow falls on it, cast by a passing bird; immediately the wings are drawn together, and all that remains is a dull

grey patch hanging from the flower, a dead leaf, nothing more. When the danger is past the wings are again opened, and the butterfly is once more to be seen sunning itself. The hum of the insects and the fragrance of the flowers encourage drowsiness, but it will not do to lie here all day.

Starting down the hill again, we keep under the edge of the wood, and presently come upon a small chalk pit that claims our attention. There are others like it; probably they have been excavated to obtain materials for road-making. These clearings are sometimes a perfect paradise to the botanist; this one, however, has no additional plants beyond those which we have already noticed on the bank. Its overhanging ledges are made of matted roots of bushes and trees, and these ledges are favourite resorts of many birds in the nesting season. It is almost too late for eggs or young birds now, but deserted nests of the bullfinch, the titmouse and chaffinch are soon found, and from a bush at our feet we unearth a late yellow-hammer's nest, with young ones in it. In the spring, when everything is in its first blush of verdant beauty, there is here quite an orchestra of music. Then to meet the fair goddess of spring—

> "The swallow circling flies,
> A clamorous cuckoo stoops to meet her hand"—

whilst—

> "The blackcap warbles and the turtle purrs,
> The starling claps his tiny castanets."

We still occasionally hear the clamour of the cuckoo (although he is now getting ready to leave us), the warbling of the blackcap and the purring of the dove; but spring has

departed for this season at least, and brilliant summer in all her radiant and gorgeous robes is here.

A few yards farther on we come to the corner of the wood, and a large hop-garden meets our view. Here, at the corner, is a plant full of the withering staminate flowers. A sharp tap on one of the poles with a stick scatters the pollen in every direction, but there is very little left now, compared with the clouds that would have been dislodged a week or two ago. The catkins on the female plants show that development is proceeding rapidly beyond the early stage.

We turn to the right sharply, and soon come upon another small chalk pit. This is less exposed than the last to the fierce midday sun, and in it immense umbelliferous plants have made their home. So large are they that our almost six feet of height disappears from view as we plunge among these gigantic herbs. The large finely-cut leaves, the peculiar shape of the flowers, and the striking mode of inflorescence, make the members of this natural order easily recognisable. The inflorescence is very characteristic. A number of short but equal stalks are given off from a common point; at the end of each of these a single, small, inconspicuous flower is produced, and, since the stalks are all of equal length, the flowers are all on the same general level, and produce that form of inflorescence known as an umbel. Frequently these primary stalks themselves produce an umbel instead of a flower, only the terminal umbels bearing flowers; this is called a compound umbel. Some of these tall plants are what is known as cow-parsnip, or as it is called by the learned, *Heracleum sphondylium*; but running along the side of the pit are plants of the common hedge parsley, one still in flower, late as it is.

What strange little blossoms this plant has! The sepals of the calyx are inconspicuous; the corolla is formed of tiny white petals, and there are five stamens and a two-lobed pistil. There is no chance of the plant being self-fertilised. Count the stamens—one, two, three, four, five. Before they mature they are bent towards the centre of the flower; then in alternate order—1, 3, 5, 2, 4—the filaments gradually curve backwards until the anthers, each in succession disappearing between two petals, are curved outside the flower. Here is a flower in which all five stamens have been twisted down, the anthers falling between and outside the petals. Not until they reach the outside of the petals do the anthers dehisce and shed their pollen. At this time the pistil is undeveloped and the styles are bent downwards, so that it is utterly impossible for the pistil to be fertilised by the pollen from its own flower. But when the stamens have discharged their pollen, the points of the stigma grow upwards, become sticky, and rapidly mature sufficiently to receive the pollen. But by this time the pollen from the stamens of the same flower has all vanished; hence the pistil must receive pollen from some other flower, if fertilisation is to take place, and this is called "cross-fertilisation." It will be noticed, then, that the flower is at first exclusively male or staminate, and afterwards exclusively female or pistillate, although both sets of organs are produced in the same flower.

Emerging from the chalk pit we cross the hop garden by a footpath, and walk in the shade of a copse bordering its opposite side. We soon come to a road at right angles to our direction, and on the left Ranscombe Farm appears in sight. The masses of bramble blossom and growing berries

make us look forward to purple hands and cheeks when autumn comes. Already on some of the most forward branches a few berries are becoming tinged with colour, but such are very exceptional as yet. The blossom attracts myriads of bees, and as we near the farm and its adjacent cottages we see that among the cottagers is a fit successor of the man described by Virgil, who—

> "First among the swains was found
> To reap the produce of his labour's ground,
> And squeeze the combs with golden liquor crowned."

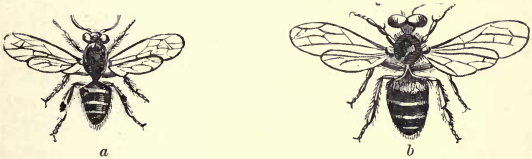
Passing through the gate we pause before the trim garden to watch the busy bee at its arduous labour; for indeed the colony is hard at work, and as the hives are partly made of glass we can observe the habits and methods of work of the bees.

You would like to learn something about bees? Well, there is so very much known about them that it is difficult to determine what to select. It is of little use telling you that there are three kinds of bees in each hive, the queen or mother bee, the drones or male bees, and the neuters or worker bees. Perhaps, though, it will interest you more to hear that the latter are really females which are not sufficiently well-developed to be capable of laying eggs, but that occasionally one partially recovers this lost power, and then is a great nuisance in the hive, her eggs always producing drones. The workers are smaller than either the queen or the drones.

These are all workers that are passing in and out of the hive. They really do the whole of the work pertaining to it, and sometimes a single hive will contain as many as fifty thousand of them. How do they work? Well, first of all,

their tongues are remarkably well developed, and thus they are enabled readily to suck the honey from the nectaries of all sorts of flowers. Then two hollow cavities are found on the thighs of the hindmost pair of legs, and in these they carry home the pollen they collect. From this, mixed with honey, they prepare a substance called "bee-bread," which they place in the cells as food for the larvæ.

The workers secrete wax from wax-glands, of which each is furnished with eight, situated beneath the abdominal segments; this they fashion into cells of a hexagonal shape,



a *b*

FIG. 25.—THE HONEY-BEE (*Apis mellifica*).
a, Worker. *b*, Drone.

some of which are used for the storage of honey, and in others, eggs are laid by the queen. When the egg hatches, the workers supply the young larva with bee-bread for about ten days, and then seal up the cell. In this closed cell the larva changes to a chrysalis, from which, at the expiration of another ten days, a bee emerges, and in a few hours takes its place in the social community of which it forms a part.

Drones are the male bees, of which, in a large hive, there may be as many as one, or even two hundred. They usually appear about May, and are very different in structure from the workers, having neither pollen-sacs, wax-glands, poison-

bag nor sting. Beyond fertilising the newly hatched queens they appear to take no part in the internal economy of the hive, except, perhaps, that they help to keep up its temperature. They are allowed to remain in the hive until the season for the collection of honey is over, and then they are turned out. In the autumn months they may frequently be seen on outhouses and in similar positions, but they soon die from exposure.

Each hive contains but one queen or fully developed female, and she is larger than the drones or workers. Generally speaking the queen, if a year or more old, is the mother of all the bees in the hive. During the height of the season she lays about two thousand eggs in twenty-four hours, so that she can in no way be considered lazy. When a hive is by any means deprived of its queen the workers immediately set to work to make one. To make one! you exclaim. Yes! They select a cell in which an egg has been laid, which under ordinary conditions would have produced a worker, then they gnaw away the partitions of the adjoining cells, and thus enlarge the one in which the egg was placed, until it is about as large as three ordinary cells. Now it has become a royal cell. As soon as the grub hatches the workers supply it with a milky food, called by bee-keepers "Royal jelly." This regal state of feeding is kept up until the grub changes to a pupa, and in due time the queen bee emerges. So highly nutritious is this special food that although her metamorphosis occupies fewer days than that of the workers, she is considerably larger. She has a long, well-developed abdomen, but is without pollen-sacs on the thighs, and is more brightly coloured than her subjects. Soon she appears at the entrance of the hive, flies out a

little way, and then returns; each time her circle of flight increases, until at length she gets some distance from the hive, and is detected by a drone. Her wedding tour is soon finished, and in a few hours she returns to the hive ready to take on the serious responsibilities of her large family.

In the spring, when the hive is full of comb and honey, and when the further rearing of young is almost impossible in the old hive, or when fresh "queen-cells" have been made, the queen gathers part of her family about her, and with great bustle prepares to quit the hive. This she usually does just before or after mid-day. Then the bee-keeper has to be alert and catch the old queen, whom he puts into another hive. The workers follow, and soon a new colony is established. If the bee-keeper be not on the look-out for the queen the swarm may escape him, and will then take up its abode in a hollow tree or some similar position. With regard to the value of a swarm there is an old adage which runs—

> "A swarm of bees in May is worth a load of hay,
> A swarm of bees in June is worth a silver spoon,
> A swarm of bees in July is not worth a fly."

Do bees keep to one particular colour in the flowers they visit in each journey? Yes, within certain limits they do, but this is to a great extent because a certain flower will be abundant in the particular area they visit; but you can readily understand how important it is that this should be so when you consider the great share they take in the cross-fertilisation of flowers.

We have spent a long time watching the bees; now let us continue our walk, or we shall not get very far to-day, after all. Out of the gate we pass, and continuing our walk across the fields, soon reach a shady path running through a copse,

in which the large rough teazle heads begin to show conspicuously, and in which there is a fine holly bush. From the grass at the bottom of yonder thick hawthorn bush a little bird creeps quietly out, and we soon detect the plain but regularly constructed nest (made of hay) of the whitethroat with four young ones in it. This is a very late nest, probably a second one. The first, mayhap, has been destroyed, although there is no doubt that those birds which pair early frequently bring off a second brood of young ones in the same year. There comes the bird back again! No, that is the male bird; it was his mate that we frightened from the nest. A chirping chorus follows, and we know that the young ones are being fed. No sooner is the father gone than the mother returns, and a similar little crying chorus is repeated, and this happens again and again. We have been sitting here almost a quarter of an hour, and during that time the mother bird has returned seven, the father nine times, and each time some caterpillar or other insect has been brought home. One or other of the birds has visited the nest every minute, and if this rate be kept up for the fourteen or fifteen hours per day that they work for food, they must capture between them close upon a thousand dainty morsels every day, including what they would require for their own sustenance. And yet very few farmers would utter a word of protest against the robbing of the nests by any of the lads engaged at work upon the farm, although "hard times" figure largely in their usual conversation. Well, at any rate we have got some idea of the work and the good that these little insectivorous birds can do. Now we are off again, but bearing round, follow the path which skirts the copse on its southern side.

On our left hand now is a potato field, patchy in appearance, some parts green and healthy, others with the characteristic brown spots scattered here and there which denote the hated disease. In some instances the whole leaf has decayed, and occasionally the stem has also been attacked. This is the dreaded "potato blight," caused by an excessively minute fungus, called *Peronospora*. We will examine one of these brown spots, for what we shall learn from it will, in most respects, be similar to what we should find in many other parasitical fungi, such as bunt, rust and

Fig. 26.—Potato Blight (*Peronospora*) magnified.

ergot. We see by the aid of a lens that a large number of upright filaments pass through the skin of the leaf, bearing on their apices little knobs which contain six or seven simple cells or spores. In the soft cellular part of the leaf a number of little fibres interlace; these absorb the sap in the cells for their own use, causing the cells themselves to decay and to give rise to the brown blotches which are so conspicuously evident. It is from these interlacing fibres that the upright stems grow, piercing the outside cuticle of the leaf, and on these the spores are developed. The spores in turn fall and germinate. The little rootlets pierce the skin of the leaf, and form another network, which gives rise in its

turn to upright filaments; these produce spores, which again develop others.

In a few hours (sometimes less than twenty-four) the fungus grows from spore to maturity, and hence we can readily understand the rate at which the disease spreads; moreover, as each spore may thus in twenty-four hours produce from sixty to one hundred fresh spores, and these again in proportion, we can readily form an idea of the cause of the rapid spread of the blight. The fungus flourishes best in a moist and warm atmosphere, a dry, hot atmosphere being as fatal to its actual growth as a cold one; 77° F. to 34° F. has been given as the range between which active growth will take place.

Although the growth of this fungus ceases beyond these limits, the cessation of growth is not accompanied by a cessation of vitality. When the favourable conditions recur every cell of the plant starts anew into life, and recommences its damaging work.

Its minute size, moreover, makes its spread easy. Dried by the sun, millions of its spores would be invisible in the air, and the wind would waft them for miles and miles, animals may carry them in their fur, or birds in their feathers, and so on. But many remain on or near the spot where they are produced, and no doubt the burning of the affected haulm, and care not to grow potatoes in successive years near an infected spot, together with the use of healthy seed, would do much to stamp out the disease. Nature brings forth in her abundance, and meteorological conditions occasionally aid her to add all foison without endeavour, and although man cannot govern these natural tendencies to occasional excessive multiplication, he can adopt measures which will render

such, so far as circumstances will admit, as harmless as possible.

We step back upon the footpath, which is here narrow, and evidently but little used. The ordinary chalk-loving flowers linger at its side, whilst the purple vetch, with its striking masses of bloom, uprears its slender stems, supporting them by means of the bushes in the copse. A row of trees crosses the field at right angles to the footpath, and under these we see what appears to be a gipsy encampment, but as we draw nearer we see that we are mistaken; the supposed gipsies are only four powerful-looking men with unkempt hair and unwashed hands, who look as if work disagreed with them, or perhaps, more correctly, as if they disagreed with work. Three of them turn their faces away and appear to be gazing vacantly across the field or into space, but a look of recognition comes into the face of one of them as he says "Good day, sir!" and through the covering of grime I distinctly recognise an individual whom I knew some few years ago as belonging to the rougher element in the neighbouring town. I nod, and return his "Good day," but my acquaintance is not inclined to let me off so easily, and, according to the usual custom of a Britisher of this class, asks me what I am going to stand. I feel as if I should like a drink myself, for it is past mid-day and the sun is high in the heavens, and fierce withal. I point out, however, my inability to stand anything in the sense desired by my interlocutor, but am met with the retort that they can drink my health presently. So I part with a coin of the realm, and have no doubt that they will fulfil their laudable intention as far as possible, unless indeed, instead of drinking my health, they couple a very different sentiment

with their libations, because I did not give them sufficient wherewith to drink to their fullest capacity.

Having obtained the desired addition to his pocket, the grimy young man returns to his companions, but as I move off runs after me, and begs us not to go in that direction, jerking his thumb towards a larch wood. I reply that that is exactly where we intend going, when he mutters a hope that I will not spoil sport. I remember what vast tracts of splendid country are closed to the public because of the stringency of the game laws, and so the required promise is, not at all reluctantly, given and on we go.

The flowers along the roadside now become brilliant with the bright red coats of the Burnet moths, which are very abundant here, and occasionally boom along in their heavy, clumsy flight. A cloud obscures the sun for a moment; the bright scarlet-robed Tortoiseshell butterfly draws up its wing, and a dead leaf hangs from the flower in its place; the Blue butterfly closes its wings, draws its legs together, and allows itself to slide mechanically through the grass to the ground, on which the pale colour of its underside renders it invisible. Soon the sun comes out again, and the copse-side once more teems with life.

We now forsake the beaten footpath, which continues across the field to the railway arch yonder, and pass along under the edge of a birch wood, till we are arrested by a fine yew tree just inside the wood, whose spreading branches hang over into the field. As we casually glance up at this, a strange-looking mass of what appears to be turf attracts our attention; but that casual glance has not satisfied us, and so we look up again, and then discover that it is a piece of lichen-covered wood which has lodged up there so

strangely. We are not quite convinced even yet, for as we are moving on a sudden thought strikes us, and we look a third time, this time with very different eyes from those we have been using. Ah, I thought so. That large ball is far too regular for a piece of lichen-covered wood! It is a nest of the longtailed titmouse, but no doubt the young ones have flown long ago. We turn into a cart track between two fields, rarely used, as is evident from the

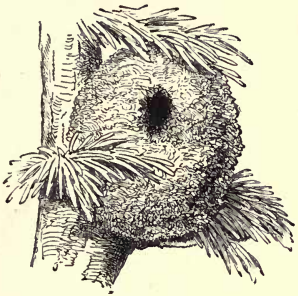


FIG. 27.—NEST OF LONG-TAILED TITMOUSE (*Parus caudatus*).

luxuriance of the brambles and clematis, and from the wealth of wild flowers, which give it a picturesqueness rarely to be equalled even in this lovely spot. On one of the thistle blossoms a Fritillary butterfly sits fanning its wings, the upper sides of which show the black latticed markings upon a rich fulvous ground, which are characteristic of this group, whilst the undersides are brilliant with inlaid spots of metallic silver let into a green and yellow frame. It is called, from the green colour of the under side, the Dark Green Fritillary, whilst its scientific name is *Argynnis aglaia*.

We may obtain a clue to the manner in which these silver spots have been developed from the relatives of this butterfly. Very many of these have spots somewhat similar in shape and position to those we see here, but in some species they are pale yellow, in others white, whilst in many the spots are more or less of this metallic character. Is there any connection between the three colours? Yes, it would appear from what we know that one is derived from the other; probably the yellow gives rise to white, and this in turn to the metallic silvery white. In a very near relation, the High Brown Fritillary (*Argynnis adippe*), we find specimens which show every possible gradation of size and development, as regards the spots, from entire absence of silver when the spots are pale yellow or whitish, until the spots unite to form silvery streaks. Here, then, the transition is very evident, and when we turn to those species in which the silver markings are now so fixed and constant, there can be but little doubt in our minds that the development has been a result of natural selection, and is of the greatest possible service to the insect. The insect before us closes its wings. How inconspicuous it at once becomes, for, as it clings closely to a thistle head, the shiny spots resemble very distinctly the shiny bracts around the capitulum on which the sun is shining.

A cornfield stretches to our right, a hop garden to the left. The bright scarlet poppies in the field are evidence of not the most careful farming, and here, at the edge of the field, is the beautiful blue cornflower, which, in spite of the dislike of the reaper, is an almost universal favourite. 'Tis of it the poet sings—

"There is a flower—a purple flower—
Sown by the wind, nursed by the shower,
O'er which Love has breathed a powerful spell
The truth of whispering hope to tell.
Now gentle flower, I pray thee tell,
If my lover loves me, and loves me well;
So may the fall of the morning dew
Keep the sun from fading thy tender blue."

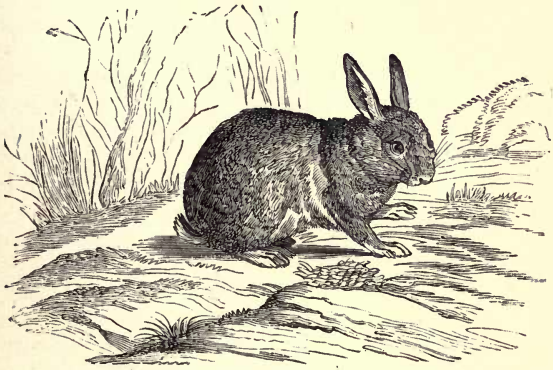


FIG. 28.—THE WILD RABBIT (*Lepus caniculus*).

We next come to a steep bank on which Chalk-hill Blue butterflies in profusion flit merrily from flower to flower. The bank leads up to a larch wood at the top, the lower edge of the wood being skirted with shady chestnut trees, and we make up our minds to sit under these and take a considerable rest.

A step forward up the bank and the white bobbing of the scuts of the rabbits is immediately followed by an almost human shriek, while a few yards ahead a rabbit bounds from

side to side in apparent terror and madness. Astonishment holds me for a moment, and then I at once take in the situation. Certainly I had promised not to spoil sport, but this is abominable. A rush forward, and I am sprawling on my face, while my ankle gives me intense pain; I am caught in one of the snares set for the rabbits. To free myself is the work of a moment, and I am soon at the rabbit's side.

Fig. 29.—The Common Mole (*Talpa europœa*).

Holding it down with one hand, I rapidly unloose the wire girdle surrounding its abdomen, and set it free, when it promptly disappears; but I soon discover that my ankle is rather more painful than I had supposed, and, limping to the shade of the chestnuts, I lie down.

As we lie at ease resting ourselves, little mounds of newly turned-up earth, which we recognise as molehills, inform us

at once how common this strange little quadruped is about here. With its short, strong neck and its elongated snout, the latter distinctly ridged along the upper, and grooved along the lower surface, without external ears, and with extremely small and well-protected eyes, we can readily understand how well-adapted the creature is for the life it leads.

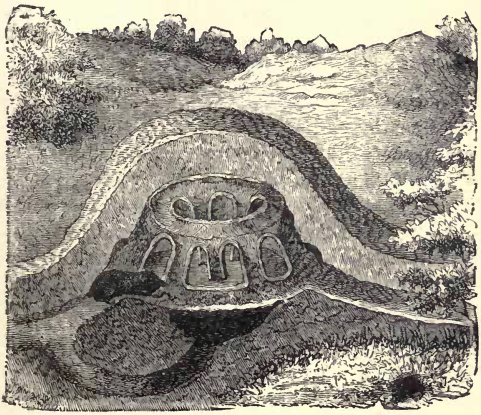


FIG. 30.—THE MOLE'S HOME.

Its short, broad, front feet, almost destitute of hair, are eminently suitable for digging, whilst the hind feet are not specially developed; but the whole muscular development of the forepart of the body is very striking. Its fur is exceedingly thick, glossy, and soft, so as to offer but little resistance when tunnelling under ground.

We see that every part of the mole's anatomy is of

advantage to it in its burrowing and tunnelling operations. Its food consists of worms and grubs that live underground, and, by ridding the fields of many pests, it is one of the farmer's best friends. Each mole makes for itself a kind of fortress, generally a raised mound, in which are two circular galleries, one above the other, and connected with each other by passages. Within the lower gallery is a hollow chamber, whilst from it a large number of underground passages are made in various directions, the whole being usually joined at their extremities by another passage forming a sort of irregular curve. From this central chamber the mole branches out in various directions in search of food, and throws up the earth it excavates here and there along its course, the little mounds being called molehills.

But this does not look a very likely place for worms; still slugs, snails, lizards and even frogs sometimes form the diet of this fierce little creature, which will scratch most vehemently when disturbed.

There is a great deal of variation in the colour of the fur of the mole; occasionally it is almost black, still more rarely cream-coloured or nearly white, but the usual colour is brownish-black, with the belly paler, although the tint varies considerably, according as you are looking at it along or against the pile. The young moles are born, three or four to a brood, in the early summer. For a few days they are almost naked, but their fur rapidly grows, and in about three weeks they are able to take care of and provide for themselves.

We are not at all anxious to continue our journey yet, but getting up to try my ankle, we wander round the edge of the wood. Here, in the damper spots, are a number of beautiful

shells, apparently those of one of the common snails, *Helix nemoralis*. The name *Helix*, or "spiral," is a very happy one to apply to the snail, is it not? The shells are not at all rare here; but it wants a really heavy shower to bring out these creatures in full force, and thus to enable us to get a correct idea of the great variation to which their shells—

> "Deftly wrought by Hand invisible,
> Painted and sculptured by th' unseen Power which works
> In all things living, and fashions out their shapes.
> The calcine atoms, drawn by that mysterious force
> Through which th' Almighty works, each to its proper place,
> Builds up by slow degrees the shell whose shape
> And beauty we admire"—

are subject. Examine one of these shells! Notice how layer upon layer has been built beyond its predecessor, as its inmate has grown larger and larger, and found its home getting too small for its comfort.

How is the shell made larger? Look at one carefully! This one draws its head back into its own substance as it were. The outside flesh nearest the shell is called the "mantle," and this has the power of secreting carbonate of lime. As the animal grows larger and the mantle stretches slightly beyond the shell, a layer of carbonate of lime and membranous matter is secreted beyond the last ring of the shell, and as the size of the animal increases, the shell is built to meet its wants, each layer extending beyond its predecessor. This goes on until the snail has attained its largest size. Here is a shell which will illustrate the matter. A membranous hood extends beyond the edge of the hard shell. This is the basement, which will become harder and harder by successive deposits of carbonate of lime until it becomes similar to the rest of the shell. The

snail shell is, of course, a univalve, that is, it is all in one

FIG. 31.—GROUP OF PULMO-GASTEROPODA OR LAND SNAILS.
1. *Helix fruticum.* 2. *Helix nemoralis.* 3. *Helix hortensis.* 4. *Helix arbustorum.*

piece, but bivalves secrete the two pieces of their shell in a very similar way.

How variable this species appears to be! Scarcely any two shells are alike, and one might well be forgiven for supposing that the extreme forms belonged to entirely different species. In nature we may safely say that no two specimens of any species are exactly alike, no two plants, no two animals, and so on. The minute differences which we see between human individuals have their representatives among all orders of living beings. Variation is the law of the universe, whilst change and decay are followed by a re-embodiment, and thus advance is made, and progress is maintained. These minute differences will not be observed by a superficial observer, to whom the various individuals of the same species will appear almost exactly alike; but to the specialist they become apparent, and enable him to individualise each specimen, and to satisfy himself that variability is indeed the general rule throughout all animate creation.

Now let us inquire for a moment what man has been able to effect by availing himself of this tendency to variation. Every one is familiar with the marked differences between the various breeds of pigeons, fowls, and rabbits that are kept by fanciers in every part of the country. These breeds appear quite distinct; there is the carrier pigeon, its excellently developed shape giving it great flying and staying power; the pouter, in which the throat membrane is developed into an expansive bag in front; the fantail, with a protuberant thorax and fanlike tail, and many other varieties. All of these have undoubtedly been developed, under the selective agency of man, from the common rock pigeon, which lives wild and builds its nest on the rocky parts of our coasts. Very similar and equally marked lines of

development are shown in our domestic breeds of rabbits and fowls, when compared with their wild progenitors. Here, then, we see at the very outset that man, by selecting individuals which show special characteristics, and by breeding from such only as show these characters in the most marked degree, has been able to fix the desired character on a definite number of individuals, until in time a distinct race has been produced. It is true that isolated individuals, even in the best selected races, show traces of a tendency to revert to the characters of their remote ancestors; but by the careful elimination of such, the race (or breed, as it is called) is kept up to a high pitch of perfection, judged, that is, from the standpoint of the artificial standard set up by the breeder. The "points" which the breeder aims at securing may be such as would be utterly useless, if not actually injurious, to the species in its struggle for existence under natural conditions; hence, if these highly-bred birds be allowed to revert to a wild state, the "points" which have been produced with such nicety may very rapidly disappear in the successive broods, until in a few years at most, scarcely any difference will be observable between their descendants and the original wild forms. So far, then, our inquiry has only shown us that a number of latent variable points may be hidden in a bird which Nature could and would seize hold of, and rapidly perfect, if it was to the advantage and for the well-being of the species that she should do so. The swollen throat, the fan-tail, and other structural peculiarities are of no value at the present time, and in the conditions under which the wild pigeon at present exists; but, given a change of environment in which any of these modifications would be of advantage, and there

can be no doubt that Nature would at once seize hold of them, and work on the tendency to vary in the desired direction so far as was necessary for the most complete well-being of the animal under its new conditions of existence.

The work of Nature, however, is generally slow, so slow indeed that a natural change of environment may not take place for a vast number of years. We must bear in mind, however, that such a change may take place suddenly, brought about perhaps by some natural force, or, still more probably, by the interference of man. Sudden changes, however, so far as they are the result of natural forces, are unusual, and we may look upon the axiom, "Natura non facit saltum," as indicating the method in which her work is usually done. When, however, a change of environment does take place, whether it be small or great, those individuals which are unable to adapt themselves to the altered conditions of existence soon die out, whilst those which are able to do so are preserved, and transmit to their offspring the peculiarities to which they owe their preservation. We can then readily understand how it is that that form which is best suited to its surroundings is finally established; but long, long before it reached its present state of excellence or fitness, it had its variable characters modified and moulded in such directions as proved to be of advantage to it, and this moulding has always been, and even now is, in progress.

As an illustration of natural selection acting over a long period, we may take our common rabbit, of which those individuals with the keenest sense of hearing and the greatest speed would stand the best chance of being and have been preserved. Again, the antelopes, which are so severely

hunted by beasts of prey on the African plains, have developed races characterised by speed and endurance. But the races produced in this manner have taken much longer to develop than if man had selected only those animals most highly developed in the desired direction and bred from them in each generation, as he has done with the race-horse, because man would eliminate more rapidly those elements which militated against the desired object. Man would produce more striking results in a short time; but the work performed by Nature is as perfect, although spread over a longer period of time.

Let us consider an instance of the production of a distinct race in response to a change of environment which is actually in progress around us. A few decades back coal was scarcely used, except for manufacturing purposes, and comparatively little even for those. Even to-day it is very little used in country villages where wood can still be had abundantly. But in our large cities and towns, and especially in the manufacturing districts at the present time, vast masses of smoke pour daily from multitudinous chimneys, and the atmosphere there is in consequence polluted with particles of carbon. When rain falls these particles are carried down by it and deposited on the ground, on fences, on trees; in short, on everything around. When the water evaporates the solid matter is left behind, and hence the fences and trunks of trees in and near our large cities and manufacturing centres are black, instead of grey or brown, which are their ordinary tints. A large number of moths rest on fences, tree trunks, and similar places, with their wings stretched out flat on them. You remember the Carpet moths on Ben Donich, and how difficult it was to see them

on account of their close resemblance to the surfaces on which they rested; and probably you have seen enough during our rambles together to enable you to understand that those individuals in whom this resemblance is the most perfect will have the best chance of escaping the kind attentions of the birds, and of bringing up a family. But as the progeny resemble (more or less perfectly) their parents, it becomes clear that in time a race will be produced which is exactly suited to its environment.

Let us suppose now that such a race has come into existence which is adapted to the tree-trunks and fences of some clean-aired country side. But a manufacturing centre springs up in the locality, with the air-polluting and surface-darkening consequences to which we have already alluded. No longer are the darker varieties more conspicuous than what has hitherto been the prevailing type; in fact, the reverse is now the case. It is these darker forms, therefore, that now have the advantage in the changed environment; the old typical form becomes more conspicuous, the birds pick these off, and soon only the darkest specimens have a chance of escape. The darkening from increased smoke goes on, the moths in each successive generation tend to get blacker, and in time a perfectly black race may be developed. This is no imaginary condition of things, but one which has occurred during the last half-century in a great number of species.

Thus the Great Mother works on. Ever toiling, never weary, she needs no rest; but night and day, summer and winter, she labours on, producing in infinite variety wonderful and marvellous results. Not an object around us but shows us the result of her handiwork, of her loving care;

nothing, however familiar it may be to us, that cannot teach us wonderful lessons, that cannot unfold to us hidden mysteries, that cannot read us a marvellous and engrossing story, if we are only earnest and intelligent enough to question it aright.

Well, we have had a very pleasant rest under the chestnut trees, but I think my ankle has forgotten the poachers by this time, so we will make a move. We climb the bank, on which here and there are bushes of juniper, whilst the grass and flowers form a carpet into which the foot sinks deeper at every step. As we near the ridge the herbage gets shorter, and wild thyme and marjoram spread their glowing mantle over the turf. Here a small but lovely purple moth with rich golden spots (*Pyrausta purpuralis*), accompanied by a smaller one in rich black velvet with a white band (*Ennychia nigrata*), flits rapidly from flower to flower, so rapidly that, numerous as they are, an unobservant passer-by would miss them altogether. Then a red insect with a pale line along the edge of the fore-wing (*Ilithyia carnella*), makes a short heavy flight for a few yards before dropping again. A grasshopper! you exclaim. Well, it flies exactly like one, but I doubt whether it is. Watch one down! That is a grasshopper, but the next one, although it flies exactly in the same manner, and is indistinguishable on the wing, proves to be a moth. The moth is undoubtedly mimicking its stronger and more powerful companion. Both are very similar in colour, in the heavy manner of their flight, and, to a certain extent, in their method of resting; but we soon learn to detect one from the other by noticing that the moth takes rather longer flights than the grasshopper.

The general tint of this grasshopper is a pretty red, and see how its long hind legs are projected. Down it goes upon the grass and is very inconspicuous until it suddenly starts up again in front of you.

Grasshoppers belong to a tribe of insects which is very different from that to which butterflies and moths belong. They do not pass through such distinctly marked stages as the latter, in which the caterpillar, chrysalis and imago, or perfect insect, are very different from one another. They have the same number of changes, but there is very little difference in their appearance at each stage. There is no resemblance between the caterpillar and the butterfly produced from it, but there is a very great resemblance between the larval and the adult grasshopper. Both have six legs (the normal number to be found in insects), both are exceedingly active, both are provided with good biting jaws, the only essential difference being the presence of wings in the adult, although there is also frequently a very considerable difference in size and colour.

Belonging to an order of insects closely allied to the grasshoppers, although not very like them, is the common earwig, which has a pair of strong forceps at its tail. The larva has no wing cases, is much smaller than the adult, and has the forceps straighter. In the pupal stage traces of elytra or wing-cases appear, the insect gets larger and the forceps become more curved. It is not, however, until the insect is perfected that a pair of large gauzy wings are developed. These,

Fig. 32.—The Earwig (*Forficula auricularia*).

when not in use, are adroitly and skilfully packed away under the elytra by means of the forceps which the earwig carries behind, and which children appear to think were formed for their special benefit.

A narrow footpath crosses the direction of our ascent at right angles, and the chalk is quite exposed here. We direct our steps along the path which we see leads into the larch wood, and observe that there is a railway cutting only a few feet to our left. A Grayling butterfly gets up quite under our feet. A large conspicuous brown butterfly whilst on the wing, it disappears as if by magic as it drops on the chalk path a few yards ahead of us. But we keep our eye fixed on the spot where it disappeared, and walk towards it, taking great care that our shadow does not fall across the spot so as to disturb it. That is certainly the exact spot where it alighted, but we cannot see it. There is nothing on the white chalk except a prettily marbled pebble. The butterfly certainly did not get up again, so we look more carefully than before, but cannot see it. It must have flown off then, after all, in spite of our keen outlook. Wait a moment! Draw your stick over the spot a few inches above the ground. The shadow of the stick falls on the pebble, when lo! that apparent pebble becomes immediately transformed into a Grayling butterfly. Another gets up, followed by many others, and after a little practice we are able to distinguish them more readily. Many, though, elude our most careful search, their greyish marbled under-sides enabling them to defy detection until the shadow of our sticks or bodies fall across them. Not infrequently we mistake a real pebble for a butterfly.

Leaving the pathway we plunge into the wood itself, our

feet sinking deep into the needle-carpeted soil. Here and there a tree has its sharp-pointed leaves brown and patchy and we find the now empty cases of the tiny little moth (*Coleophora laricella*) which frequently does so much damage to the larch trees. We are soon glad to return to the path, and after walking a little farther we find that the larch, plantation is situated on the outskirts of a wood of more mixed growth.

We are lazily inclined this afternoon, and soon sit down again. Dreamily watching the ground near our feet we see a large red ant crossing our path, followed by another and another, all going in the same direction. We know this fellow well. He is called *rufa*, and well deserves his name. Others follow along the same track, so that there must be a nest near. Let us see if we can find it. Do you see that decayed old tree-trunk yonder, with only about six feet of the stump now left? All round it, built up against it in all directions, so that the stump forms the central column, is a conical mass, about six feet in height and twenty feet in circumference at its base, and composed of a great many small pieces of stick and straw. That is the ants' nest. This one is by no means exceptional in point of size; probably we shall see others quite as large, or larger, during our afternoon's stroll. You must be careful not to let an ant sting you, because the result would be very painful, and you might find swellings as large as marbles on your legs or body; so don't let any get into your clothes.

Fig. 33.—Wood Ant (*Formica lignipeda*).

Ants belong to the same large order of insects as bees—the Hymenoptera—which is characterised by the possession by the perfect insect of four membranous wings without scales, the anterior pair of these being usually linked by hooks to the posterior pair. Their habits are very wonderful. How busy they are all round that nest, and notice the regular paths in which they travel. This one, you see, is without wings. It is a worker, and workers never have wings; they are born wingless. Besides this worker-form of the red ant, who builds the home and forages for food, there are two other forms—the males and females. Both males and females have wings, but after they have paired, the males soon die, whilst the females break off their wings and become wingless, and not unlike the workers. Ah! there is a female. See how rapidly she moves her wings to and fro. Then, suddenly crossing them, she pulls them quickly from side to side, and after a time they fall off. Sometimes, however, the workers remove them. When they lose their wings the females become queens, are attended by a regular bevy of workers, and set about the great business of their lives—egg-laying.

These immense, thickly populated cities of the ants have a very simple commencement. A single female is taken possession of by one or a few workers. An eminent observer has noted that a fertile female wandering at large has often a single worker hanging on to her in a rigid manner, which is thus carried wherever she goes, and surmises that in these cases the two start the nest in combination, the worker doing the necessary labour. The female then lays a few eggs, which the worker or workers carefully tend. These become grubs, then pupæ, and finally ants, which help the founders of the

nest to build up a larger structure; then a larger number of eggs are laid, corresponding to the increased size of the nest, and so the process goes on, until at last nests of the size of the one we are watching, with millions of inhabitants, are produced. A female ant has been known to lay as many as 5,000 eggs. Sir John Lubbock, our greatest authority on ants, states that the larvæ often appear to be sorted out according to age, and their appearance, collected in groups of different sizes, reminds one of a school divided into classes. As we carefully pull away some of the material forming the top of the nest, observe the galleries, the rooms, the pathways. But matters are beginning to look serious; millions of ants crowd to the point of assault; and see, they are carrying away little silken masses in their mouths. These are the cocoons in which are pupæ which will, in their turn, change to ants, and on which the future state of the colony depends. How rapidly the workers catch hold of the little silken bags in their mouths and disappear into the uninjured parts of the nest, never stopping until they have removed them to a place of safety; and even when a part of the nest has been irretrievably ruined, when the *débris* looks nothing but a seething, struggling mass of life, when millions of these tiny creatures have been thrown into what appears to be irretrievable confusion, the workers securely hold on to these pupæ, and disappear with them almost as if by magic.

The way in which ants look after these silken cocoons probably gave rise to the supposition that ants stored up grain for the winter, the cocoons bearing some distant resemblance to grains of corn. They are now very generally though erroneously called ants' eggs, and as such are frequently collected and sold as food for poultry. But at the

same time it is well known that there are several grain-storing ants, some with most interesting peculiarities. For example, some grow their own grain, whilst others again remove the growing point of the seed when storing it, and thus prevent germination, and so on.

When the male and female ants first leave the nest and fly in the air, they are sometimes in such immense numbers that the air is quite blackened with them. On a hot day in August, 1893, when on Ben Bheula (a mountain to the west of Loch Goil), at a height of some two thousand feet above the sea, I was sitting on a little heathery knoll when I suddenly found myself surrounded by a cloud of small black ants, which crawled into my nostrils, ears, mouth—in fact, all over every exposed part of my body. Fortunately I had a gauze net, such as is used for catching butterflies, with me; this I quickly dropped over my head, beat a hasty retreat, and soon got clear of the vast horde, which must have numbered millions. In some cases their numbers have been so great that they have been taken for smoke. Thus, in 1866, a paragraph in a daily paper recorded the occurrence of an immense swarm of ants around the spire of a church in Coburg. Firemen prepared to make the ascent, and the whole neighbourhood turned out to see the fire. When the firemen reached the top of the tower they were seen by the spectators below to be apparently warding off the attacks of something, and, rapidly descending, they reported that the smoke was nothing more than millions of winged ants gyrating about the steeple. As far back as 1814 another remarkable swarm was recorded by the captain of a hulk lying in the Medway, who noticed something black floating down the river with the tide. A boat was sent off, and a bucket full

of the suspicious matter brought on board, when it was found that the floating substance was a mass of winged ants. The report states that the living mass was about five or six miles long, eight or ten feet broad, and six inches thick.

The social system of ants has won the admiration of scientific men, who, on account of their wonderful intelligence, have placed them, in company with bees, very high in the scale of animal understanding. Lubbock is of opinion that the ant ranks next to man in the scale of intelligence, and when we consider their social economy, we must own that he does not err. From the earliest times man has recognised their superior development in this direction, and we need only refer to king Solomon's advice: "Go to the ant, thou sluggard; consider her ways, and be wise," to remind ourselves that the wisest of men have thought their industry and method worthy of praise and emulation even by the human race. Their intelligence in communicating with each other, the excellence of their social relations, the self-abnegation of the individual for the welfare of the state, make their society an ideal commonwealth. To them the common weal is everything; individual passions and attachments are unknown. Truly we may agree with Lubbock when he writes: "When we consider the habits of ants, their social relations, their large communities and elaborate habitations, their roadways, their possession of domestic animals, and even, in some cases, of slaves, it must be admitted that they have a fair claim to rank next to man in the scale of intelligence."

That ants can communicate with each other we can prove by experiment. Let us kill one of these crawling over the path. You notice how regularly the ants go along in definite

directions to and from the nest. That one has just detected its dead comrade; notice how rapidly it runs from side to side, and round and round the dead body, investigating it. Now another and still another come up. These go back to the nest, and before long they return with some of their comrades, and carry away the dead body.

We have been speaking of the "intelligence" of the ant. Intelligence has been defined as a "conservative principle which will always direct effort and use into lines which will be beneficial to its possessor." So far as the lower animals are concerned, the definition is peculiarly happy, as it does not imply the possession of that power of exact reasoning which we associate with our idea of human intelligence. Our own processes of reasoning are largely—I had almost said solely—intellectual operations of the mind, but in the lower animals such reasoning power as they may possess is essentially the direct result of an elementary recognition of advantage to the individual exercising it. Such reason as this is essential to intelligence; in fact, neither can exist without the other; and it is in this respect that intelligence differs from instinct.

The connection between intelligence and instinct is so direct and close, that we may consider the former as a direct result of, and development from the latter. Some of the simplest forms of intelligence in the lower animals are but little removed from, and cannot be properly differentiated from, the highest forms of instinct. Yet, whilst the latter results in actions which are automatic and spontaneous, the former presupposes a mental operation of some sort, however simple it may be. Even now we are not altogether on safe ground, for unless we admit that instinct involves some mental

operation, we have only reflex action, and yet such operations must be transmitted directly to the offspring, and be inherent in the individual at the time of birth. We say that it is by instinct that the young cuckoo ejects from the nest the rightful occupants, whom it supplants, and whose place it takes, so far as the attentions of the parents are concerned. There can be no real mental operation performed by the young bird at this early age. Its action, resulting as it does in the destruction of the young birds whose place in the nest it usurps, and in its own advancement, must depend upon the imprint it has received of the experiences of successive generations transmitted by heredity during thousands of years.

An action like this, which we could not perform without the guidance of experience, when it is performed by a young animal devoid of experience, and without knowledge of the purpose for which it is performed, is instinctive. It cannot be said to be due to reflex action, for in reflex action muscular work is effected, or brought about by a suitable stimulus, without the intervention of a mental process, or of mental cognisance. There can be no doubt that the young cuckoo is aware of what it does, for when any of the birds which have been ejected are replaced in the nest, it will turn them out again and again.

In much the same manner the spinning of a spider's web is instinctive, for if the web be broken, the spider will renew the broken part. The spinning of cocoons by caterpillars, in which to hybernate or pass the winter, and the selection of suitably protected spots for the same purpose by moths, butterflies and other insects, are further instances of instinctive acts. On a level with these may be considered the

ability of many mollusca, such as snails, limpets and others, to find their way to and from a selected site in search of food. This has been termed "homing," a very happy phrase, suggestive of the instinct which leads them to return, as it were, to their homes. Again, the migrating power of locusts, butterflies and other insects denotes a knowledge of the absence of food in a given locality, and of the necessity of seeking pastures new, in order to obtain a fresh supply. The case of the migration of butterflies and moths is specially striking, because the result of their action is to

Fig. 34.—Social Wasp (*Polistes gallica*).

benefit their progeny, and not themselves. The migrating instinct in birds does not show any greater advance on that of locusts, than their much higher development would warrant us in expecting.

Whilst, therefore, we may look upon instinct as the application of a general inherent reasoning capacity, the possession of individual reasoning power at once raises the intelligence to an immeasurably higher level. It is related that a wad placed in the entrance of a wasp's nest in such a manner that it could only be removed in one direction was at first attacked in front, then at the side; finally, by descending

into a hollow between two bricks, where the nest was placed, the wad was successfully pulled away. This happened a second time, but on the third and subsequent occasions, the wasp went directly into the hollow, and removed the wad, illustrating beyond question an actual ability to reason and to remember. A certain amount of reasoning power is also exhibited by spiders. The first light touch on a web will cause the spider to rush out to see the cause of the disturbance; a second and a third will generally produce a similar result, but after that, the spider can rarely be tempted to stir, unless a very considerable period of time has elapsed since the last disturbance.

We all know the wonderful way in which the intelligence of the higher animals may be increased by training; but even among the lower classes, effects of a similar kind can be produced. Many of us have seen itinerant showmen with troops of trained fleas, which have been taught to march, draw carts, and do other amusing tricks, showing that even such humble creatures are capable of receiving instruction, probably even of thinking. The training of creatures like fleas must be a matter of much greater difficulty than is the process in the case of the higher animals. The following story of the way in which a chaffinch made friends with a gentleman is told in a recent number of *The Feathered World.*

"Some years since, in my garden in Ireland, a chaffinch had made her nest, about five feet and a half from the ground, in a Gloire de Dijon rosebush growing on the pathway, and trained on an east wall. Twice I had observed her fly from the bush as I approached, and I took no notice, as it did not occur to me there was a nest. On the third occasion I observed her fly out I examined the bush, and

discovered the nest. Thinking it a pity to disturb her constantly, as I was so often passing her nest, I in future began to speak to her in a kind tone of voice when some six or eight paces from her nest, and continued so speaking until I had passed her. Though she would fly out when any one else passed—even the gardener—she never left her nest again when I passed. As the days went on I would stop opposite the nest and talk to her, daily going nearer to her, until at last I would separate the rose leaves with both hands, and talk to her from a distance of about eight inches—sometimes less. But the storms came, the nails gave way, and the rose bush and nest were detached from the wall. She could sit still on her nest, but another storm would probably have wrecked it. Armed with hammer, nails and list, I proceeded to repair the damage. At first I spoke to her in the usual way, then drawing a little to one side, I raised the hammer as high as my mouth to let her see it, when she at once flew out, alighting on a shrub about four yards off. She watched my every movement while I was securing her nest, and I would turn about occasionally to speak to her. In time four little birds came out. After they were half grown I seldom found her on the nest, but she was never far away, as, after talking to her little ones, I would generally find her sitting near, with food in her mouth, when I turned round. At last they all disappeared, and for, I think, about two months, my little chaffinch was but a pleasant memory, and I never expected to see her again, as this was to be my last year in Ireland. But it was not so. Here it is necessary to explain that on passing along the path where the nest was to my house, there was a railing in line with the path, and opposite the

house, which latter was about three yards from the railing. At right angles to the path and railing was a stone wall some nine feet high. One evening, when returning from my garden, I had stopped to open the little gate on my right, the stone wall being in front of me. Now occurred one of the most extraordinary and pleasing things I had observed in bird life. Something dropped from the wall, which I at first thought was a large leaf. On looking down, however, I was gladly surprised to see my sweet chaffinch. There she sat, full of confidence, with legs bent, wings slightly extended, tail and head raised, her eyes looking into mine, and only a yard from my feet. 'My sweet one,' I said. When she knew she was recognised she immediately returned to the top of the wall, and there, *mirabile visu*, were her four little darlings, which she had brought to show me! I spoke to her in the usual tone, while I gazed at her and them: 'Sweetie, sweetie, my pet, my sweet one;' and never was seen, I think, a prouder or happier bird than that little chaffinch. She chirruped and moved with quick jerky motions, as if wild with delight, while the four young ones gazed at me with bodies and necks extended to their fullest height, and evidently wondering what it was all about. She had remembered my kindness during the two months or so she had been absent, and did not bring her little ones until they were fully feathered and as lovely as herself. Here was evidence of memory, pride, affection, gratitude, and shall I say reason? Why not? After talking to her for some two minutes or more, I opened the little gate, still talking to her, when she and her little ones flew away, and I did not see her again. During a long career this is the most pleasing and sweetest memory I have of bird life."

Very closely related to this form of intelligence is that by means of which domesticated animals learn to do that which we require of them. By carefully selecting dogs with certain peculiarities and habits, and breeding exclusively from such of their descendants as show an intensification of such peculiarities, it has been possible, after the lapse of a considerable number of generations, to produce a number of separate breeds, such as pointers, retrievers, fox-hounds, grey-hounds and others, which are remarkable for the facility with which they learn to do special kinds of work. That the faculty is inherited is certain, for well-bred dogs will do their special work with scarcely any need of teaching. Thus far it is perhaps instinctive, but a very little tuition and practice converts it into intelligence of no mean order.

But to return to ants. In no way, perhaps, does their intelligence become so evident as in the way they keep slaves, and obtain food from the aphides they maintain in close proximity to their nests. It is very interesting to observe the manner in which they set about capturing slaves.

There is a rather large red ant, *Formica sanguinea*, which is not uncommon in Kent, Surrey and other parts of the south of England. If during the summer one of the nests of this species be opened, a number of small black ants will be found in it, as well as the larger red ones. These small ants are called *Formica fusca*. As soon as the nest is disturbed both kinds of ants run out to defend the home, but when they perceive this to be hopeless, and that the pupæ are being disturbed, they unite in efforts to carry them off to a place of safety. The little black ants are scarcely ever allowed to leave the nest, the red ants doing the work of

collecting food, whilst the black ants appear to be purely household slaves. Strange to say, in Switzerland, where these two ants have exactly the same connection of master and slave as in England, but where the slaves are usually in greater relative abundance, some of the latter are allowed to join their masters on their foraging expeditions.

We can hardly leave the slave-making ants without mentioning one other species, *Formica rufescens*, another red species, be it observed. The males and females do absolutely no work. The females produce eggs, but when these hatch, the neuters or workers have not the capacity to bring the larvæ up. These neuters, however, are active enough in capturing the slave species, *Formica fusca*, and conveying them to the nest. The latter appear to offer considerable resistance to their capture, but the larger ants are generally successful in obtaining pupæ, which they carry home, and which, in due time, produce ants, which become household drudges to their masters. Once the slaves are domiciled in the nest they take upon themselves the whole of the household duties, even to the building of the nest in which their masters live. They tend the young larvæ and pupæ, and when it is necessary to leave one nest and seek another, the slaves settle everything (according to Huber), actually carrying their masters in their jaws. The same author records how, on one occasion, he shut up thirty of these ants with a bountiful supply of the food they liked best, but without a slave; so helpless were they under these conditions that, although they had their larvæ and pupæ with them—everything, in fact, to stimulate them to work—they were actually unable to feed themselves, and several perished. The advent of a single slave, however, soon altered matters.

It at once set to work, made cells for the larvæ, fed them and the surviving adults, and soon restored the colony to a flourishing and thriving condition.

How this slave-making instinct originated is doubtful. It is well known that ants which are not slave-makers will carry off pupæ of other species, to be used for food. If these pupæ hatched before they were required for that purpose, they would naturally do such work as they would have done in their own nest, and their presence proving useful to those in whose nest they found themselves, the collection of pupæ would probably be persevered in, and in time such collection may have become the sole aim of certain species, their household duties in the same manner becoming gradually and at last entirely delegated to their prisoners.

The keeping of aphides for domestic purposes by ants is even still more wonderful. Aphides or plant lice are the insects which are sometimes found in vast swarms on a variety of trees. Their abundance is due to their ability, during the summer months, to bring forth young without sexual action, and to the rapidity with which these come to maturity. An aphis in the early summer brings forth a number of young alive by an advanced process of gemmation. In a few hours, if the temperature be moderately high, these become adults and produce young themselves, so that in a few days vast swarms are thus parthenogenetically produced. But it is not with their marvellous powers of reproduction so much as with their ability to excrete a sweet sticky fluid, called "honey dew," that we have to do. In some years the leaves in gardens and woods are covered with the thick sweet viscid fluid, and moths and other insects forsake the flowers and feast on this "honey dew" with avidity. The ants

have found out the advantages of "honey dew" as a food. They do not, however, care to go in search of it, but prefer keeping the aphides near their nests, and for this purpose collect them from a distance, and place them where they can be frequently visited. When an ant wants some honey dew it strokes the body of the aphis gently with its antennæ, and this soon causes the aphis to lift up its body and excrete a drop of the limpid juice. Many naturalists have tried to copy the actions of the ant and, as it were, artificially to cause the aphides to excrete, but they have never been successful. The excreted matter is a waste product in the economy of the aphis, and sooner or later has to be got rid of; but the ant appears to be able to secure its discharge at will.

It is very remarkable, too, how readily ants are able to discriminate between members of their own and members of other colonies. Even when the eggs of one species are hatched in the nest of another, they are at once known to be intruders, whilst if members of their own nest are removed for a time, and then returned to the nest, they are at once recognised as friends and relations.

Perhaps in no way have ants shown their intelligence in communicating with each other more than in their forays and battles with other ants. An American observer records that whilst watching a battle between *Lasius niger*, a black, and *Lasius flavus*, a yellow species, he frequently saw the yellow ones drop to the rear for refreshments, whilst on the same side a special body of ants were told off to look after the wounded, forming, as it were, a kind of ambulance corps. The yellow ants frequently sent back for reinforcements, and at last drove off the invading black ants, who had attempted

to capture their herd of aphides. A second battle, however, some time after, with another colony of black ants, ended disastrously for the yellow warriors, as they were all killed, and their herds appropriated by their black opponents.

During these fierce battles the ants would appear to be guided by certain officers, and to hear and obey certain words of command; and that they are capable of combining their forces against man, the following incident, narrated by Dr. Livingstone inhis *Narrative of an Expedition to the Zambesi*, will show:—"We tried to sleep one night in a native hut, but could not because of attacks by the fighting battalions of a very small species of *Formica*, not more than one-sixteenth of an inch in length. It soon became obvious that they were under regular discipline, and even attempting to carry out the skilful plans and stratagem of some eminent leader. Our hands and necks were the first objects of attack. Large bodies of these little pests were massed in silence round the point to be assaulted. We could hear the sharp, shrill word of command, two or three times repeated, though, until then, we had not believed in the vocal power of an ant, and the instant after we felt the storming hosts over head and neck."

Another well-known naturalist, writing of Indian ants, states that "the roar raised by a squadron of *Lobopelta*, if you poke at them with a straw, does not require to be listened for with your hand to your ear," and further amusingly suggests that the organs by which the sounds are produced are "military drums."

Can ants talk then? you ask. Not as we understand talking, perhaps, but they make certain sounds which they understand, and by means of which they can communicate

with each other. It has been shown quite recently that many different kinds of ants possess special stridulating organs of the greatest delicacy and articulated with the greatest perfection, by means of which they can produce a considerable variety of sounds, although how far they can modulate them is an open question. These organs consist of a special apparatus, which is placed on the hind margin of the second abdominal segment, and which is scraped over a

FIG. 35.—HONEY-COMB WITH FULL AND EMPTY QUEEN CELLS.

series of delicately raised and perfectly regular lines on the middle of the back of the third segment, a perfect co-adaptation existing between the two sets of organs.

Probably bees rank next to ants in point of intelligence. The wonderful structure of the cells of which the comb is composed, the almost mathematical precision with which they are formed, the ability of the bee to make them of such a shape that they shall hold the maximum amount of honey whilst requiring the minimum amount of wax, all point to instinct in the very highest condition of development, and yet capable of very simple explanation. Natural selection has taught the bees, when commencing their cells, to sweep

equal spheres at a certain distance from each other in a double layer, to excavate bases until the hollow spherical bases almost break into each other, then to work up the wax excavated along the lines thus formed, at the same time hollowing out the basal corners farthest removed from the adjacent cells until the walls become hexagonal in shape and of such a degree of thinness that the honey may be contained in them without the walls being ruptured by its weight. The storage of honey for the winter months is absolutely necessary to a hive bee, and we can readily understand why nature should eventually lead them, by a few simple instincts, to become such skilful architects, although they themselves have no knowledge of the curves and angles, or the perfect workmanship exhibited in their work.

Thus far, then, we may suppose the work of the bee to be due to a high form of instinct, but cases are on record in which the bees have shown decided marks of intelligence. In some cases pieces of comb have become detached, and in danger of falling, when the bees have detected it and fastened it into position again. In one such case a thick layer of wax was built between the falling comb and the next piece, thus securing it firmly; whilst thus secured the detached piece of comb was fixed at its top to the roof of the hive, after which the first horizontal support of wax was taken away to be used elsewhere—a decided proof of intelligence of a distinctly higher type than that shown in the construction of their cells, and yet resulting in the using of as little material as possible, compatible with the successful carrying out of their undertaking.

We have previously spoken about the means of communication between ants; it has been just as satisfactorily

determined that similar means exist between bees. A celebrated observer declares that they have a number of tones which they emit from the stigmata placed along the sides of the thorax and abdomen, and that by these means communication with each other is made. A bee that brings news passes it on to a comrade, and this to another, until the whole of the hive is in possession of the information. If the news be satisfactory the bees go on with their work as usual, but if the contrary, flutter and excitement rules the hive for the time.

Well, we must say good-bye to the ants now, or we shall be tempted to go on moralising for ever. We strike into the wood, and guide ourselves as best we may in the direction of the railway cutting. It is tough work forcing our way through the undergrowth, but we reach the cutting at last, and climb down the bank, not hurriedly, but with the greatest possible consideration for our safe arrival at the bottom. The chalk crumbles here and there, and hardly have our feet left it before a large mass tumbles into the cutting. That was a near shave! I exclaim, as I steady myself by a clematis root, whilst another piece of chalk is precipitated headlong. Slowly, carefully we go, and at last we are down, and harking back a short distance, until we are opposite the spot where we first discovered the Grayling butterfly, we climb the opposite side, and sit on the edge to examine a piece of the chalk we dislodged, which proves to have a fine fossil *Micraster* in it.

How much there is of interest in a piece of common chalk! Place a fragment under the microscope, and you will see that it is composed of tiny little shells. In the Atlantic Ocean at the present time live millions of minute animals,

called *Globigerina*, and these have the power to extract carbonate of lime from the sea-water, and to use it in building up the shells which cover them. These shells are full of tiny holes or *foramina*, and from this circumstance the group of animals to which they belong are called *Foraminifera*. Millions of these little creatures die every year, and their shells, dropping to the floor of the ocean, form a kind of mud, called Globigerina ooze. Samples of this ooze have been obtained by means of dredging apparatus, and under the microscope it has proved to be almost identical with common chalk in structure. No doubt, in the far, far future, these beds will be elevated above the sea-level, and form solid rock. In this way, undoubtedly, most of our limestone and chalk rocks have been formed.

Scattered here and there through the chalk are numerous remains of various sea animals—fish-bones, sponges, sea urchins, shells, etc. These were, when alive, made up partly of organic and partly of mineral matter. After death, the soft, organic parts decay, fine particles of carbonate of lime are deposited in their stead, and after a time, an exact duplicate of the original animal, or part of an animal, is formed, but made of carbonate of lime. The deposits of succeeding years and ages bury this deeply in the ooze which was being deposited at the time it was formed. Thus have many of our fossils been formed. In this way we can peer a little into the dark recesses of the long ago.

We leave the edge of the railway cutting, and, getting over the fence, find ourselves on a sloping bank very similar to the one on the other side. The sun has long since reached its zenith, and is now rapidly westering, as we know by the slanting shadows that fall across the bank. It is still

very hot, though. The sky is cloudless, and the bank slopes towards the south; so we select a large hazel bush, and in its shade lounge listlessly, watching the insects as they still flit joyously from flower to flower. Gradually our position changes, and we find ourselves gazing dreamily on one of the beautiful pictures nowhere, perhaps, seen in such perfection as here. Acres upon acres of fast-yellowing grain stretch all over the valley, broken here and there by the dark foliage of a hop-garden. Pleasant-looking farm-houses, embosomed in trees or nestling in orchards, give an appearance of happiness and contentment to the scene. The birds keep up a tuneful concert; the larks soaring high in the clear blue vault above, carol their gladsome melody, the sweetly modulated notes of the linnet, as he sits on yonder bush of juniper, the full rich tones of the merle and mavis, the sweet twitter of the mad little tits, and the love-song of the dove, all add through the ear to the charm that delights the eye. Yet, than all this entrancing music, the poet has imagined a richer orchestra, a musician with—

> "A melody loud and sweet
> That made the wild swan pause in her cloud,
> And the lark drop down at his feet.
> The swallow stopt as he hunted the bee,
> The snake slipt under a spray,
> The wild hawk stood with the down on his beak,
> And stared with his foot on the prey:
> And the nightingale thought, 'I have sung many songs,
> But never a one so gay;
> For he sings of what the world will be
> When the world has died away.'"

But what is that staring straight at us? Be still a moment! Do you not see two eyes like sparkling diamonds

gazing at you most intently? Bright, steady and unwavering is that inquisitive stare all the while we remain still, and do not further disturb it. Ah! you have moved. See! Off like a flash goes the tiny brown creature, and it dives with a rustle into the grass, and is soon out of sight. Walk along the bank cautiously and quietly! There is another looking at you with its bright, intelligent eye, as it lies basking in the warmth of the brilliant sun. You move again; there is another rustle, another quick retreat, and you soon lose sight of this one also. Not quite lost this time, for there it is again, stealthily making its way towards that hole under yon thorn bush. Now it is gone altogether!

Fig. 36.—The Common Lizard (*Lacerta vivipara*).

But we have not found out much about the little creature yet. We must watch one carefully. Sit down on the bank here, and keep your eye on its hiding-place! We sit perfectly still, and the little fellow soon creeps out, and settles itself in the sun again, basking there in apparent laziness and enjoyment. A fly settles near it. A sudden dart, and the fly disappears, as if by magic, into the mouth of the little lizard. If the lizard does look lazy and drowsy, he certainly sleeps with rather more than one eye open. A little caterpillar wriggles out of that twisted leaf, and by means of a little silken thread lets itself down to the ground.

The lizard pounces upon it, and shakes it somewhat as a terrier does a rat, then proceeds leisurely to eat it.

Now let us capture it! Quietly and gently we creep towards it, and rapidly place a hand over it. Carefully it is picked up, but notwithstanding all our care, the little creature's tail snaps off as soon as we handle it, and it wriggles tailless out of the hand, and gets away again. Another tail will soon grow in its place, and specimens are occasionally captured which appear to have been actually provided by Nature with two caudal appendages.

Young lizards abound on this bank, and very lively little things they are. They are usually born in the hottest part of the year, and, as in the case of some other reptiles, the eggs are matured in the body of the parent. The young ones, however, do not escape from the egg-shell until the time of birth, although the general opinion prevails that the lizard is a viviparous reptile. The young lizard is darker in colour, and altogether smaller and more clumsy than the adult, but otherwise there is very little difference between them in general appearance.

Like most reptiles the lizard occasionally changes its skin, but this is not done so cleanly and perfectly as is usually the case with allied animals. In fact, the skin appears to be shed piecemeal, instead of leaving the body in an entire mass.

On the approach of winter the lizard prepares to hybernate. Selecting some well-protected hole it crawls into it, and soon passes into an entirely torpid and lethargic condition, in which state it remains until the warmth of early spring revivifies and re-animates the little creature.

In common with almost everything reptilian, the common

lizard is dubbed as poisonous by the ignorant labourer, and it is brutally killed when met with by those to whom, indeed, its preservation should be a matter of solicitude. But it has many foes besides ignorance. Snakes, vipers, hawks, and many other animals and birds, feed on it ravenously. Its remarkable similarity in colour to its surroundings undoubtedly aids it greatly in its "struggle for existence" against such powerful opponents, and its wonderful agility frequently stands it in good stead. The farmer, however, should protect it as much as possible, the good done to him by these little creatures being simply incalculable.

But the day is far spent. The shadows of the surrounding bushes grow longer and longer as the sun's rays become more and more oblique. We will not go yet, however. Everything is so quiet here, so peaceful. Let us wander by the edge of the wood. Here is a plant of the Fly Orchis! How perfectly does the flower of this interesting plant mimic the insect after which it is named, each blossom resembling, even to the production of all the various parts of the body, a fly crawling up a stalk, just as the Bee Orchis resembles, to the smallest particular, the insect after which it is named. Of it the poet writes—

"'Tis Nature's plan—
Religion in your love to find,
And know for this she first in man
Inspired the imitative mind.
As conscious that affection grows
Pleased with the pencil's mimic power,
That power with leading hand she shows,
And paints a bee upon a flower."

Here is a bed of one of the slender-leaved trefoils. How pretty these little plants are! What a wealth of sentiment

clings around them in Ireland. The "shamrock" is truly a word to conjure with there, and yet the botanists of the Emerald Isle are not at all agreed as to what plant is the true shamrock. Two share the honour, the Lesser Yellow Trefoil

FIG. 37.—THE PURPLE CLOVER (*Trifolium pratense*).

(*Trifolium minus*) and Dutch Clover (*Trifolium repens*), whilst a very near relation of both is the Purple Clover, the "holy clover" mentioned by the poet when he sings—

> "Woe to the wight, who meets the Green Knight,
> Except on his faulchion arm,

Spell proof he bear, like the brave St. Clare,
The holy Trefoil's charm."

The name *Trifolium* is well applied to these plants, the three little leaflets which help to form the compound leaf being very characteristic of the clover group of leguminous plants. Both the species of trefoils named above have their champions, who support one or other of the species as the real shamrock, and a census has recently been taken in the various Irish counties as to which species is in most general use as the shamrock. In several counties both *T. repens* and *T. minus* are used indiscriminately, in others, only *T. minus*, whilst in those of the western sea-board, where old-fashioned Irish ideas and customs still most largely prevail, *T. repens* is most in vogue. There is considerable difference between the two plants that thus dispute the palm for pre-eminence, but it would appear that by those who are sufficiently well educated to know that there are more trefoils than one, the smaller-leaved *T. minus* is usually chosen, and the absence of the white and black markings which usually occur on the foliage of *T. repens* is a *sine quâ non* with such, when choosing their sprig of shamrock. Possibly, as these species are so closely allied botanically, both have been long used under the popular name; in any given district that species which is more abundant there, being probably used more generally than the rarer. At any rate, both species appear now to be in, what may be termed, general use, and both equally do duty as the "shamrock of old Ireland."

Now we will go back to our old spot under the hazel-bush, and watch the sun gradually sink, and the western horizon gradually assume its rainbow tints. The lovely crimson

overspreads the vault above, whilst long streaks of orange-fire shoot upwards into space, until the fiery orb has hidden itself completely behind the larch trees. Here we feel that the soul and Nature are attuned together. Here we feel that Nature speaks to us through something higher and nobler than we have known before. Here we are far from the grasping, striving world, "too much with us." Do we not feel that Nature breathes nothing unkind, but that she rather softens our hardness, expands our sympathies, and calms us in trouble and distress?

Darkness creeps slowly on; the crimson glow of sunset fades and fails; the brilliant tints disappear; the zodiacal light shines clearly, extending far above the horizon. Slowly we wend our way homeward. Sweet beyond all things is the soft wild-flower air, borne to the senses by fairy breezes. Charming beyond description is the still gentle vesper of the woodland birds; and though we miss the delicious minstrelsy, and the sweet "jug, jug" of the nightingale, who has long since become silent in our woods, we still have the soft music of the whitethroat, the tender melody of the yellow-hammer to charm our ears until darkness overtakes us, accompanied by the ventriloquism of the night-jar and the gentle murmuring of the trees, whilst the glow worm lights our path, and the fragrance of the honeysuckle scents the summer night. The day has given us food for reflection, and here, in the living stillness, we feel with Byron that—

> "There is a pleasure in the pathless woods,
> There is a rapture on the lonely shore,
> There is society where none intrudes,
> By the deep sea, and music in its roar—"

and with attentive ear and eye we open our minds to the manifold wonders and beauties around us, our ears charmed by the solemn night music, and our eyes by the infinity of space. We pace the chalk hills on our homeward way, interested and well satisfied with the attempts we have been making to interpret some of the many mysteries around us, to read some of the many wonders of Nature, enjoying some of the purest pleasures that the embodied soul is capable of realizing, pleasures which, with the usual plenitude of all Nature's productions, are practically boundless and inexhaustible.

MARSH.

LEVEL, unpicturesque, dreary and monotonous to the ordinary observer, is that long stretch of marshes extending along the banks of Father Thames between Gravesend and Sheerness; but it offers a perfectly peaceful haven, a quiet, aye, an almost sacred nook to the naturalist who seeks to discover its hidden treasures, and to unravel the mysteries they contain, and who, "far from the madding crowd," finds never-ending pleasure in this lonely, yet interesting spot.

Miles upon miles of level land are here, intersected in every direction by ditches which carry off the surplus water, and thus render the marshes, at least in part, an excellent pasturage for hundreds of cattle and sheep. Here, too, are reed-beds innumerable, among which the wild duck, coot and water-hen delight to make their nests; great patches of the giant bulrush tower above its less striking neighbours; through these the water-vole skilfully forces his way, and among them the silent dabchick successfully resists the attacks of its numerous enemies, whilst on the confines of the district at the Edge of Grayne, the beautiful tern carries on those aërial gambols by which it has earned the name of sea-swallow from the unscientific but observant natives.

Here, too, the sedge-warbler is to be seen and heard, its

charming musical notes carried far into the still silence of a midsummer night, whilst the grasshopper warbler almost rivals it in this nocturnal minstrelsy. With delicately modulated, ever-changing tones, these two songsters form an almost complete bird-orchestra by themselves in their evening concerts, whilst by day the little reed-warbler dodges in and out among the reeds, now and again trilling its simple melody, and occasionally joining in the later concerts of its summer friends. Occasionally one may find the interesting

FIG. 38.—TURNSTONE (*Strepsilas interpres*).

nest of the last-mentioned bird, interwoven with the greatest care among the reedstalks, forming with its round, broad top and pointed bottom, a deep, inverted cone, in which, when the wind blows strongly and the reeds are almost forced down to the water's edge, the four greenish-white and red-freckled eggs or the downy young ones rock safely to and fro. In the shallow pools the graceful dotterell sometimes abounds in the autumn, whilst the stately heron, far from his home in Cobham Park, may be seen all the year round, fishing in the pools for his daily bread.

But it is in the winter that the bird life of these marshes is most interesting. Though our summer songsters have then ended their visits, and have left our shores for milder climes, either to revel in sunny Mediterranean skies, or to bathe in tropical sunshine, these marshes still swarm with feathered inhabitants. The rarer natives are then increased in numbers by migrating hordes from more northern latitudes, whilst many visitors come, which are never to be seen in

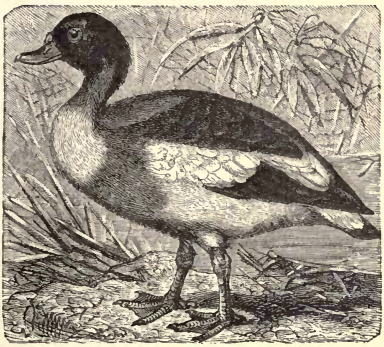


Fig. 39.—Brent Goose (*Vulpanser tadorna*).

summer time. From the pine forests of Scandinavia and Russia come buntings, fieldfares and redwings; from the islands of the Arctic Ocean, the turnstone, sanderling and snow bunting; whilst the siskin leaves its furze bushes in the far, far north, and joins the ring-ouzel from the burns and torrents of Scotland in its journey hither. Then, too, the hooded crow comes inland for food, whilst the common gull, the blackheaded gull and the lesser black-headed gull

may be seen sporting with their greater and lesser black-backed relations, the herring gull and little gull joining in the sport, or, intent on business, carefully fishing along the river side. Then, too, the buzzard and woodcock may be noticed, whilst in the winter evenings the wild duck falls noisily into the cool silent pool, accompanied, perchance, by the bean goose and the brent goose, and there, lulled by—

"The ripple washing in the reeds"—

they remain until the first grey streak of dawn awakens them to the pleasures and duties of another day.

But this is a lovely afternoon in June, and in the copse hard by we can still hear the cuckoo crying his name to all the hills around, whilst the turtledove purrs her love-song in the elm, and the nightingale and blackcap warble their delightful melodies. There the swift skims rapidly along, and the wagtail also helps to remind us that winter is far, far away; for all these charming visitors leave us and wing their way to softer and sunnier climes before the cold hand of winter is laid upon the landscape.

Directly behind us lies the little village of Cliffe, a quiet, dreamy old place, in which one may vegetate for a time in comfort and quietude. To the east and west runs the most northerly ridge of chalk belonging to the North Downs, its direction clearly marked by the row of smoky chimneys belonging to the cement factories that are scattered along its route. It extends far beyond Gravesend, which, although only a few miles distant, is now almost hidden by the haze caused by the filthy exhalations from these chimneys, and passing through Northfleet and Greenhithe, terminates near Dartford. From the base of the hills to the river the ground

is flat and marshy, and consists of more recent deposits of alluvium.

In these gravel and mud beds have been found many remains of prehistoric man; of man, that is, who existed before the earliest civilization of which we know anything, so long ago, in fact, that, in comparison, the 7,000 years through which we are able to trace history back until we reach the early Egyptian civilization, constitute a quite insignificant period. At what time man first appeared on the earth can probably never be certainly determined, but some approximation to the truth may be arrived at by a careful study of the mysterious history which Nature has hidden in the crust of the earth, fragmentary records of which are from time to time brought to the surface.

Long ages ago our globe was, it is believed, a hot fluid mass, which gradually cooled until its outer crust became solid. In the process of cooling the solid shell became wrinkled, while, at the same time, the vapour by which it was surrounded condensed to form the ocean, which, settling in the hollows, under the action of gravity, left the crests of the wrinkles exposed to the action of those atmospheric forces which we know so well. Frost and snow, running water and heat broke up this exposed surface; the *débris* was carried off by streams and rivers, and deposited as sediment on the floor of the ocean, until little by little the original crust was covered with these sedimentary deposits. These being disposed in layers gave rise to what are called the "stratified" rocks, whilst the original crust formed from molten matter constitutes what are termed the "igneous" rocks. From the earliest times until now stratified rocks have been in slow process of formation. You will remember

what I told you, when we were on the hillside, about the Globigerina ooze now being deposited at the bottom of the Atlantic. The total thickness of these rocks has been estimated to be more than twelve miles. During their deposition the remains of animals and plants have been buried in them, and the hard and bony parts of these undergoing petrification have thus been preserved as fossils.

The stratified rocks have been arranged by geologists in four groups. Of these, the oldest is termed the Primary, the next oldest the Secondary, then the Tertiary, whilst the most recent is called the Post-Tertiary or Quaternary. Each of these groups is sub-divided into systems, and these again into formations, each formation being marked by characteristic fossils. In the Primary group the most important systems are the Silurian, the Devonian and the Carboniferous. The Secondary group is characterised by the abundance of beds of limestone; the Lias, the Oolite and the Cretaceous are its chief systems. The Tertiary and the Post-Tertiary groups consist more particularly of shallow alluvial and estuarine deposits.

As we study the various formations and the fossils contained in them, we find that at different periods in the history of the earth most of the leading classes of animals and plants attained a high state of development, and having reached their zenith, gradually declined.

We have already alluded to this point as illustrated by the vegetable world; here we will consider it in relation to the animal creation. The Old Red Sandstone, which lies below the Carboniferous rocks, is remarkable for the high degree of development exhibited by its fossil fishes. When, after long ages, we come to the era of the Liassic and Oolitic

systems, we find that the "age of fishes" has passed, and instead, there are remains of gigantic crawling and winged reptiles; creatures, of which we can form no conception from the study of the reptiles of to-day, were then abundant, and this period has been called the "age of reptiles." Ages again pass; vast changes of temperature and climate occur; the large reptiles become extinct; the Tertiary rocks appear, and the "age of Mammals" (of which man is one) is reached, although a few remains of mammals are found in the Secondary rocks. The abundance of fossils of Mammalia in the Tertiary strata, furnish us with a great deal of material for study, and we find traces of a progressive development from extinct forms to those which now exist on the earth. Many of the animals whose remains are discovered, have long since become extinct; but man, who may have had a hand in their extinction, as he certainly has in that of many in recent times, has certainly lived side by side with some of them, and by means of his peculiar ability to adapt himself to his environment, as well as by his skill in overcoming his enemies, has been enabled, in spite of his comparatively weak physical development, to survive them in that struggle for existence which is going on between the stronger and the weaker of Nature's children.

The remains found in the earth show that, whilst undergoing development in the direction of becoming more civilized, man passed through four distinct stages. These are known as the *Palæolithic* or *Old Stone Age*, the *Neolithic* or *New Stone Age*, the *Bronze Age* and the *Iron Age*. During the first two of these periods, the use of metals appears to have been unknown, the weapons used by man having been made principally of flint, bone or wood. The weapons are

found all over the world in rocks both of Tertiary and Post-Tertiary age, and there is very considerable difference in the skill with which they have been fashioned, the earlier being roughly chipped or hewn, the later more or less smoothly polished. With the former we find remains of the mammoth, cave bear and woolly rhinoceros, whilst with the latter there are no remains of any of these animals, which had evidently become extinct. During the New Stone Age we have good reasons for supposing that agriculture was practised, and several animals for the first time domesticated. There can be no doubt from the great difference in the workmanship, and from the gradual transition from the rudest to the most highly polished stone implements, that the two "Stone" Ages covered a very considerable period of time.

Most of the material upon which the conclusions concerning pre-historic man are based, has been found in the Post-Tertiary deposits, or in chalk and limestone caves. The Post-Tertiary rocks themselves consist of (1) A layer of grey gravel, above which is (2) a layer of red gravel, whilst on the top of this again is (3) a layer of loam. In these deposits are found the remains of the mammoth, woolly rhinoceros, Irish elk and many other extinct animals, besides those of the reindeer, hippopotamus, lion and other animals which have since migrated from their old dwelling places, or have otherwise become more restricted in habitat.

But it is in the caves that the greatest amount of interest centres. These are found in chalk and limestone districts, and have evidently been made by the erosion of running water. They were used during vast periods of time as the lairs of man and of the various kinds of animals whose re-

mains are found in them. How have these remains been preserved through such vast ages? When rain-water soaks through chalk or limestone it dissolves, by virtue of the carbonic acid gas which it contains, a quantity of the mineral matter; but when the water evaporates, the solid matter is left behind. The bones of animals which have used these caves for lairs, and the bones of the victims on whom they have preyed have, whilst lying on the floors of the caverns, been soaked in the water which has found its way through the rock above into the cave, and the water evaporating, the solid limestone matter which was dissolved in the water has been left behind. The bones have then become hardened, and the ordinary organic parts decaying, their place has been taken by the deposited limestone, until the whole has become calcified. In the course of ages the floor of the cave itself is raised by these limestone deposits, the bones are buried, and their relative position in the ever-thickening floor thus formed, gives us a clue to their relative age. Preserved in this way we find the remains of man which, by their position, must have existed before the mammoth was extinct, and at a time when the reindeer was an inhabitant of Central Europe.

By the actual remains of man, then, and by his works, we read his history in the past, not clearly nor distinctly, but brokenly and dimly, yet, in spite of the piecemeal character of the evidence, with a large amount of certainty withal. This history has to be sought out and inquired into by those who would pierce Nature's deepest recesses and inquire into her greatest secrets, by those votaries who find their greatest enjoyment in the interpretation of what appears to more superficial observers to be hidden, and in unfolding

these mysteries to those who are ignorant, or who pay but little heed to what is going on around them.

But it is not by flint weapons of the Stone age, by bronze weapons of the Bronze age, or by iron weapons of the Iron age alone that we connect the long, long ago with to-day, nor by a few isolated fossilized bones, which are without doubt, human remains. The weapons and human bones teach a part only of this great lesson, and man's existence at this far-off time is further proved by the finding of large numbers of human skulls in various parts of Europe and America. Almost fifty have been found in Europe alone, and these differ so much that they are supposed to belong to no less than three different races. They are all of Post-Tertiary age, however, and it is remarkable that the most primitive type of skull occurs as an atavism among the peoples of to-day. These, therefore, add their quota to the lessons taught by the human bones and man-made weapons, lessons to which the most sceptical must pay attention.

The remains of man and of his handiwork have been found under crystalline stalagmite and other deposits, which have been estimated to have taken more than 500,000 years for their formation. Moreover, at a period anterior to that of any existing mammal, so far as we can learn from its geological traces, the earliest evidences of man's existence are found mingled with the remains of animals long since extinct. We can trace Egyptian civilization back seven thousand years by historical data. We can trace the hand of man in Egypt alone far beyond the earliest time to which these historical records carry us. The time that has elapsed since the reindeer and man were common inhabitants of France; the changes in climate which have since occurred;

the time that rivers have occupied in wearing away their present beds since they formed the gravel beds in which the traces of man's skill are found; the time necessary for man to advance from his earliest condition to his present state of civilization; the time necessary for the slow extinction of animals, which we know to have been contemporary with early man; all these are things which must be imagined, for they cannot be absolutely measured in years. Definite times or limits cannot be assigned, but we know that some of the remains of man are pre-Glacial, and astronomers have calculated approximately the time at which the position of the earth with regard to the sun was favourable for glacial conditions; their mathematical investigations have led them to assign figures closely approximating to those arrived at by other and independent lines of thought, based on philology, geology and palæontology.

Well, these beds of gravel have carried our minds far away, but let us return to the present. To the east the marshes stretch as far as the eye can see, being lost to view, as, with a sudden curve, the river trends southwards, to reappear farther on; they continue, in fact, without break until Queensborough and Sheerness are reached. Before us, to the north, only a few hundred yards distant, is Father Thames, flowing lazily to the sea. "Lazily," did we say? Placid and peaceful enough the river looks as it wends its way onwards, ever onwards, but lazy as it appears, it does a great deal of work.

It has been estimated that the river discharges into the sea daily one thousand two hundred and fifty million gallons of water, and that each gallon holds in suspension

about twenty grains of mineral matter. It has further been calculated that this would amount to a daily discharge of solid matter equal to one thousand five hundred and fourteen tons, of which about one thousand five hundred tons are in the form of chalk (carbonate of lime) and two hundred and thirty-eight tons of gypsum (sulphate of lime).

Whither does this solid matter go? It is not all carried to the sea, for the water around the mouth of the river has

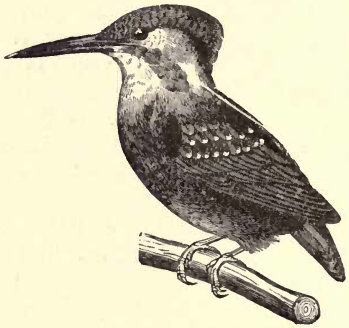


Fig. 40.—Kingfisher (*Alcedo ispida*).

a much smaller proportion of both substances than is the case higher up. Part of the solid matter is held in suspension, and this is deposited as mud so soon as the water becomes still enough. But it is the matter in solution for which we have to account. No doubt this is mainly used by fishes and sea animals for the formation of their bones or shells. A few miles below us is Whitstable, celebrated for its oysters. It has been calculated that every

oyster requires about fifty thousand times its weight of water to obtain the mineral matter necessary for the formation of its shell. With such numbers as these one can soon account for the disappearance of vast quantities of these shell-making substances. So Father Thames is not so lazy after all.

The most brilliant denizen of the marshes passes us like a flash. None can compare in beauty with the kingfisher, which, like a sapphire meteor, passes and re-passes us again and again, as it darts up and down the pools and ditches, resting occasionally on a stump stretching over the water, but diving off rapidly as it spies its prey, which it eagerly seizes and at once bolts almost whole, unless in some sheltered hole, forsaken years ago maybe by a water-vole, it has a nest and young ones, when the food is quickly carried home. I dare say it has a nest in the bank there, but it would require a very long search to find where it is hidden, and when found it would probably prove a still more difficult task to get it out. There is a smart little bird in a bright coat of yellow, tinged with red, its back spotted, the crown of its head pale, but the sides black. It is not a reed- nor a sedge-warbler. It is rather a conspicuous fellow, but this is the first I have noticed; I dare say it is the aquatic warbler, a much rarer bird than its fellows. This reminds me that a few winters ago I saw the beautiful but rare waxwing, with its bright, red-tipped feathers, on the edge of this selfsame marsh!

Yonder is a heron, its grey livery rendering it almost invisible against the mud-banks despite its great size, and very different from the starlings standing on the sheep's backs yonder which are picking the ticks from the

sheep's skin. There, too, are some rooks aiding the starlings in their beneficent work, and so intent are they on their labour that they do not notice us until we get close to them, and then they only fly lazily a yard or too, and return as soon as we have passed on. A wild-duck whizzes up into

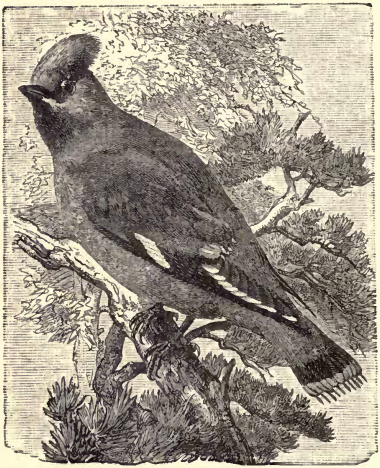


Fig. 41.—The Waxwing (*Bombicilla garrula*).

the air, and we soon discover its nest with a plentiful supply of eggs. This is followed by another and yet another, and we soon recognise that they must be preserved here, and that we are treading on dangerous ground. Then a coot takes quietly to the water from yonder clump of sedge; it is too far out for us to reach it with a stick, but the regular

way in which the sedge is interwoven with iris and reeds bespeaks a nest in the centre of the clump; so, taking off boots and stockings, we are soon looking at seven stone-grey, red-spotted eggs, from which we trust seven young coots will shortly be safely hatched.

Rising from the water side, we notice the lovely fern-like, feathery, delicately cut, and most exquisitely tinted leaves of the water dropwort; but, in spite of its marvellous beauty, we remember that it is most poisonous withal. And along the ditch banks, what a mass of vegetation there is. Great plants of *Epilobium* and *Galium* are mixed with reeds and the broader-leaved bulrush. Here, in the slimy mud, its large rhizomes visible on the surface, its fibrous roots sinking far below, and its long, sword-like, glabrous leaves standing some three or four feet above the water,

FIG. 42.—THE YELLOW FLAG (*Iris pseud-acorus*).
a, Transverse section of three-celled ovary.

is a bed of the yellow flag or *Iris*, as it is scientifically called. True, this particular species does not exhibit in its flowers any of the many-hued, varying changes of tint that the latter name suggests, but some of its relations are of the brightest tints, and in their purple hues vie even with the brilliancy of the rainbow. To the same family of flowers belong the crocus and the beautiful gladiolus, one of the gardener's pet creations. The wild flag has a flower of simple yellow tint, as its common name indicates, but its flower is nevertheless remarkable and worthy of attention.

If you will examine the flower you will note that the perianth consists of two whorls (or rings) of yellow leaves surrounding the stamens; there are three in each whorl, those representing the calyx being larger and more striking than those which represent the corolla. The former are reflexed or bent back; the latter, which take the place of petals, are placed alternately between those representing the sepals, so that they leave a space on either side of the central line of each sepal. From the bottom of each of the three sepals a stamen rises, and these, with their long filaments, are also rather deflexed, and fall just above the central line of the sepal. The bases of the sepals are rounded into nectaries. The most wonderful developmental structure in the flower is the stigma or upper part of the pistil. Instead of being rounded, or divided into filaments, as is the case in so many flowers, you will observe that it forms three long petaloid structures which also are deflexed, and bend over the stamen, reaching the sepals, and thus forming a sort of arch, under which the stamen rests secure.

Although the structure of the flower is thus complex enough, the method of fertilisation is very simple. A large

bee with a long tongue forces its head under the arch formed by the coloured stigmas, to get at the nectary at its base. If the stamens are mature, the pressure makes them dehisce or open on their lower surfaces, and the bee's head is immediately covered with pollen; the bee, when it has rifled the nectary of its honey, flies to another flower. But the gummy part of the stigma is placed in the direct path of the bee as it climbs over to reach the nectary, and some of the pollen is left on the gummy surface as *Bombus* pushes its way under the arch of another flower, from which it in turn gets another supply of pollen the while it is robbing it of its honey.

It is not only on marshes such as this that the yellow flag is to be found. It occurs in bogs, upon hillsides, by the edges of ponds in woods, wherever, in fact, the damp collects sufficiently for it to thrive. Its sword-like leaves are used in mimic warfare by boys, and this practice is referred to by Scott in the lines—

> "But yet from out the little hill,
> Oozes the slender springlet still,
> Oft halts the stranger there;
> For thence may best his curious eye
> The memorable field descry,
> And shepherd boys repair
> To seek the water flag and rush,
> And rest them by the hazel bush,
> And plait their garlands fair;
> Nor dream they sit upon the grave
> That holds the bones of Marmion brave."

Does not the sight of the yellow flag, too, bring to mind its French name, *Fleur-de-luce?* and we remember that under the name Fleur-de-lys it is the national floral emblem of that country. True, we talk about the "lilies of France,"

but it is the *Iris* that is figured, and its close alliance with the lilies undoubtedly caused it to be included in that general term before scientific botany and the classification of plants were even in their infancy. Sufficient that their leaves showed the same general characters, that their flowers approximated in some degree to a general conformation, and the use of the old name "lilies" for most showy monocotyledonous flowers may be readily understood.

We have become quite enthusiastic over the *Iris*, but as we lie on the soft grass and look into the water, we notice an apparent shadow motionless therein. Do not stir; I will tie a small piece of stick to this string. Now I drop it on the water. The apparent shadow at once resolves itself into a little fish, which darts forward, tugs manfully at the stick, and making no impression on it, returns to its original position. It is a male of the three-spined stickleback, beautifully rose-coloured now, and there, just behind him, near the root of that bulrush, is a little elevated mass of mud, into which have been woven small pieces of stick and fragments of plants, the whole covered in at the top with mud. This is the stickleback's nest in which the lady stickleback has deposited her spawn, which he is now watching so jealously. Nothing will be allowed to come near it until the young fish hatch, which they will do in about a fortnight. Strange little objects the young fish are when first hatched, with the yelk-bag attached to them; but this soon disappears. Then the father's duties are over, and the young fish are left to shift for themselves.

We leave the stickleback, our attention being attracted by a number of beautiful dragon-flies, which are skimming rapidly over the water, hawking for flies. Just observe one

carefully as it plays round yon mass of gambolling midges. Up and down, round and round, forward and backward it goes; but with every movement its jaws close, and a fly is enclosed in that rapacious maw. A sudden sweep with a stick, and the spoiler lies stunned and helpless on the ground. There are actually two or three flies still sticking from its mouth, and, judging by the movement of their

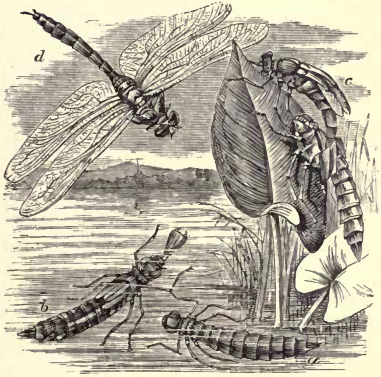


FIG. 43.—DRAGON-FLY.
a, Larva; *b*, Nymph; *c*, Imago emerging from Nymph; *d*, Imago.

bodies, they are scarcely dead, but they are held by those powerful jaws in a most tenacious grip. Observe the powerful wings, with their exquisite network! Mark the large head, and the peculiar way in which it is fastened to the thorax! Note, also, the powerful jaws and large compound eyes.

Would you like to know something about the life of a dragon-fly? Its segmented body and six legs tell you that

it is an insect, but it does not go through its metamorphoses quite like a butterfly or moth, nor like a beetle. As you know, all these have three very distinct and separate stages besides the egg—the caterpillar, the chrysalis, and the imago or perfect insect. In the second of these stages the insects are in a most helpless state; they are almost incapable of movement, neither eat nor stir, and have to adopt various means of protection to enable them to escape from their enemies. The differences, too, between caterpillar and chrysalis, and between chrysalis and imago, are also very great, but in dragon-flies—

> "Those
> Dull-coated things, that making slide apart
> Their dusk wing-cases, all beneath there burns
> A jewelled harness, ere they pass and fly—"

these changes are not so marked, and with the exception of the final metamorphosis there is but little transition from one stage to the other. Their caterpillars are provided with six good walking legs, like the adult, and they run about the muddy bottoms of pools and streams, devouring all kinds of small insects which come in their way. They are very like the perfect insect, except that they are at first much smaller, and have no wings. As they get larger they cast their skins, like the larvæ of other insects, and presently traces of wings appear. The insect is now in its pupa or nymph stage, corresponding with the chrysalis of a butterfly, but it still keeps up its active habits and its character for rapacity, disposing of as many victims as in its earlier stage. After a time it ceases to feed, crawls up a reed or other water plant, and when above the surface of the water, fixes itself firmly to a resting-place. Soon the

skin on the back splits open, the dull wing-cases slide apart, and after a few wriggling motions the dragon-fly in jewelled harness emerges, its wings, however, being small and crumpled. Rapidly these expand, and the dragon-fly wings its way to attack other winged flies, just as in its earlier stages it waged bitter war on the inhabitants of the pool in which it lived. The poet has observed this metamorphosis, for he sings—

> "An inner impulse rent the veil
> Of his old husk; from head to tail
> Came out clear plates of sapphire mail.
> He dried his wings; like gauze they grew;
> Through crofts and pastures wet with dew,
> A living flash of light he flew."

Yonder is a row of strange-looking willows, with short, thick trunks, and large massive heads from which rise numberless thin shoots and twigs. These trees have the young shoots lopped off every year for the purpose of basket-making, and it is this continuous cutting that gives them their peculiar appearance. Walking over to them, we find that the leaves have been eaten, and that some of the branches are almost bare. There is one of the culprits, a large green caterpillar with white stripes down the side of its back and a short horny spike near the end of its body. This is the caterpillar of the Eyed Hawk moth, and, see! there are several others stretched out at length near the end of the twigs; they look so much like a terminal leaf at a little distance, that, in spite of their large size, they are not very conspicuous. Taking one of them in our hands, we see that it has a large head and powerful jaws, whilst on each cheek six simple convex lenses represent its eyes. Its body is made up of fourteen rings or segments, the first three

forming the thorax, the last eleven the abdomen. On the sides of the first thoracic and the first eight abdominal segments are to be seen a couple of small transverse slits or openings. These are the spiracles, and lead into little air-chambers, from which tiny air-tubes spread all over the body, and convey the air necessary to purify the blood. Each thoracic segment bears a pair of legs, but, though these are the true legs, the caterpillar, as you see, does not use them for walking, but only to steady its food when eating, and you notice that each leg is provided with a short, dark hook. The skin on the under side of the third, fourth, fifth, sixth and last segments of the abdomen is extended downwards, forming projections called pro-legs or claspers, and although these are not true legs, it is by means of them that the caterpillar walks; hence they are sometimes termed false legs; we notice that to make them more effective they are composed of joints, and that these are partly retractile, the one into the other. Try to pull the caterpillar from the twig on which it rests, and you will not find it an easy matter, for the end joint of these pro-legs is provided with minute but very powerful circles of hooks, with which it clings tenaciously to the twig.

Touch that caterpillar on the twig with a stick; it brings its head and thoracic segment up suddenly, and throws them back, at the same time withdrawing its head into the front thoracic segment. At this time, with its bright stripes, its anal horn and thrown-back head, it looks very peculiar, and probably, by assuming such an attitude, prevents many small birds from attacking it. This threatening attitude is, however, shown much better by the Privet Hawk moth, in which it is so marked that this insect and a few close

relations with the same habit have been called Sphinx moths, from a fancied resemblance, when adopting this peculiar position, to the Egyptian Sphinx.

There is a larva of the Eyed Hawk moth, in which the bright green colour is changing to purplish brown. This shows that the insect is nearly ready to pupate. On the tree, among the leaves, its green colour aids it in escaping from those enemies which prey on it; but when full fed it has a long journey to make along the branches, down the

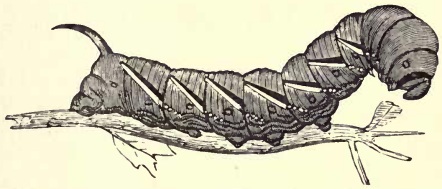


Fig. 44.—Caterpillar of Privet Hawk-Moth (*Sphinx ligustri*).

trunk, and perhaps for a considerable distance over the ground, before finally selecting a spot in which to burrow, for it changes to a chrysalis underground. The green colour would be very conspicuous as it crawled down the trunk and over the dark ground; but by changing to a dark purplish-brown colour, it becomes much less conspicuous, and is much more likely to escape. This is not the only larva that changes thus. Most of its near relations which have green larvæ do the same, and each one generally changes his tint thus, before—

> "Deep under earth his darkling course he bends,
> And to the tomb a willing guest descends;
> There, long secluded in his lonely cell,
> Forgets the sun and bids the world farewell.

Here is a strange caterpillar staring at us with its bright red head drawn back into the swollen thorax, the whole thrown back threateningly, thus giving it quite a formidable aspect, whilst the tail, divided as it is into two fine filaments, adds to this appearance. You need not be afraid of it, dangerous as it looks. Touch it! Ah, from the under side of the first thoracic segment, directly below its mouth, and which is placed straight towards you now that its head is raised, it squirts a fluid upon your hand. You draw back quickly. A piece of blue litmus paper put into the fluid becomes red, from which we know that the fluid is acid. If I had a little bicarbonate of soda here, I would put a pinch into the drop of fluid, and effervescence would follow. The acid is called "formic" acid because it was first obtained from ants. You touch the caterpillar again on the opposite side, and immediately the threatening head is brought round to the fresh point of attack, and some more acid is squirted. It is evidently by the sense of touch that the caterpillar is guided as to the direction in which to squirt the fluid. Having seen how well the caterpillar of the Puss moth can protect itself, let us now examine the glands from which the fluid comes. Quite at the centre of the ventral surface of the first thoracic segment, and placed transversely across it, we find a narrow slit. By squeezing this, four little processes are pressed out, two on each side, whilst between these is a central gland in which the acid is secreted. Have the caterpillars of other moths such an arrangement? Yes; some moths closely allied to the Puss, but smaller, and hence popularly termed Kittens, have very similar glands; but they are unable to use them as the Puss moth does, and there is no doubt that, although not so conspicuously useful, they sub-

serve a very similar protective purpose in many other caterpillars.

But mark! the larva of the Puss moth is showing us another of its peculiar methods of protecting itself. From the two-pointed filaments into which the tail segment is divided, two long pink flagella, or little whips, are being thrust out and drawn back with great rapidity. Quite an alarming appearance, you say. Indeed it is. The thrusting out is called evagination, the drawing in, invagination, and

FIG. 45.—THE PUSS MOTH (*Dicranura vinula*), MALE.

we note that the flagella are withdrawn, as it were, into themselves, drawn in like a glove in process of being turned inside out, or a telescope that is being shut up. The tip disappears first, and as the flagellum is drawn in, each part from the apex to the base disappears in turn, until only a tiny raised point shows where the base is. When evagination takes place, the basal part expands first and the apex is the last to come from the inside. One of our very best naturalists tells us that the power of contraction in the retractor muscles of these organs is enormous. Many other caterpillars have eversible glands, some of which give off irritant fluids,

others odoriferous; but there can be no doubt that each subserves some purpose beneficial to its possessor.

We have found a great deal to interest us on these willows. Let us turn now to the trees themselves. The willows are a botanically interesting group of plants, although botanists try to make them as difficult as possible to understand. They have a very great tendency to vary, and slight differences have been seized upon by specialists to divide what are probably really only a few distinct species into almost a hundred different kinds, which no two botanists name alike. Even the plants which bear the different sexes of the same flower offer a certain amount of difference; for you must remember that, like so many of our trees and shrubs, the willow has the stamens and pistil borne not only in different flowers, but on different plants. With the earliest advent of spring, before almost any other trees and shrubs have wakened into life, the willows put forth their luscious blossom, and provide a banquet for thousands of insects both by day and by night. By day, flies swarm to the feast; by night their place is taken by hundreds of moths, which revel in the intoxicating nectar secreted by the bloom. Very different often at that time is the appearance of two bushes close to each other. The one has its slender boughs covered with bright yellow catkins, the other, with catkins which are green, and the latter bush is altogether wanting in the brightness of its neighbour; the former bears the staminate, the latter the pistillate part of the flower. In those early spring days, too—

> "When the yellow catkins cover
> All the slender willows over"—

an uncanny-looking individual with a comprehensive com-

panion known as "Gamp," may occasionally be seen as night approaches wending his way to marsh or sylvan solitude, to shake the intoxicated moths after nightfall from the catkins into the ample folds of outspread "Sairey." Carefully he handles them; longingly he looks at them; triumphantly he transfers them in little boxes to the pockets of his coat. What a world of labour he bestows on the treasures which he finds on his lonely rounds! Lonely? Scarcely lonely you would think if you were to follow the wanderer on his rounds and hear his muttered thoughts, or see in the flicker of the lamplight the smile beaming on his face as he espies a special favourite, or the gesture of disgust as Sairey is turned upside down owing to the plebeian nature of her contents. You would be quite satisfied that he was far from being lonely, that he had companions you wot not of, that he was holding communion with spirits far enough away, aye, altogether unseen by you, but near enough to hold his mind in constant action. No, he is not lonely, with Sairey, the lantern —and his thoughts.

The flowers of the willow have neither calyx nor corolla. The staminate flower consists usually of two stamens, on slender stalks, enclosed in a leafy scale; the pistillate flower consists of a simple ovary with a forked stigma, also enclosed in a leafy scale. But a large number of these small leafy scales with their contained stamens or pistils, as the case may be, are congregated close together on a central stem, and thus form a conspicuous bunch or catkin; the staminate catkins are covered with the beautiful bright yellow pollen dust which is set free when the stamen is mature.

One broad-leaved species of willow is called sallow, and the catkins of this, which by Kentish people is called

"palm," are largely sought after in many of our English counties to decorate the churches on Palm Sunday.

But at this time of the year the catkins have long disappeared, except here and there a few dry brown remnants which serve to remind us of the bygone glories of spring. The foliage is thick on the trees, and we see here where the willow "grows ascaunt the brook," that it "shows his hoar leaves in the glassy stream." The white under side of the leaves contrasts strikingly with the bright green of the upper side, and the reflection of the under side in the clear water illustrates to us the truth of the poet's observation.

We must linger no longer here, but must get on. We are nearing the river now, and at last we get hemmed in. There are dykes all round us, and apparently there is no way of escape; they are too broad to jump over, too muddy and unsavoury to wade through. Ah! here is a narrow piece of wood, only about three or four inches wide, stretched from one side to the other. You don't think we can cross on that? Oh, yes, we can. I daresay we shall get our feet wet, but it is better than getting them covered with mud. You must be careful, though, how you cross. A piece of wood three inches in breadth is not the safest possible thing on which to cross a twelve feet dyke, but it would not do to have it wider, or the sheep would be able to get across it, and so stray. I remember well my first acquaintance with these narrow planks of wood on which the crossing is made. I had come here with a friend to observe the habits of certain insects which are confined to these marshes, and which only fly at nightfall. To make sure of getting off the marshes again when our observations were completed, we hired a man from the neighbouring village to go with us. All went well

whilst daylight lasted, but at sunset a faint mist came on, and increased slightly until everything seemed dim, indistinct, and uncertain in the twilight. For a time all went on successfully. Then each of my companions, in negotiating hurdles over the ditches, had in turn found a leg disappearing in the murky depths below, and had pulled the said leg from its moist surroundings, rather the worse as regards colour and smell. When these catastrophes happened to my friends, I, forgetful of the good old adage, "Do not holloa until you are out of the wood," had smiled—smiled, not because I rejoiced at their misfortune, nor with hilarity or vulgarity, but with just the ghost of a smile, the reflection of an inner consciousness of satisfaction that I as yet had escaped. At present I had not a wet leg and my companions had, and I felt thankful that, if Fate had decreed that two of us should be wet and dirty, it was they and not I who had been unfortunate. Not that I had reached the stage of selfishness. Oh, no! I pitied them, I was sorry for them, but still I was pleased with myself. Then we came to a broad ditch; the green, slimy *Lemna* and other pond weeds covered that ditch with an alluring carpet; a narrow plank spanned it; by the side of the plank was a stout pole, some seven feet in length, with one end driven deep into the slimy ooze. This pole worked, as it were, in the arc of a circle. Catching hold of it with the right hand, pressing it firmly into its muddy bottom, and keeping it quite close to the plank, it becomes a wonderfully useful adjunct in the tight-rope performance of crossing. I understand the mechanism of this pole now, but I did not then. Our guide went first. Grasping the pole firmly with his right hand, his arm went through the segment of a circle, as with three or four rapid

steps he traversed the plank; then, with a short, sharp, backward jerk, the result of long experience, the pole was swiftly circled back for the next comer. Secretly, I rather funked the plank; there was a set look about our guide's face which showed that the crossing was a rather more serious business than any we had undertaken in this line yet; besides, the light was bad, and in the haze the ditch looked wider than it really was. But I still had dry trousers, and the knowledge of that fact made me feel confident. Chaffing my friend at the already wet condition of one leg, I suggested that he should go next. He did not hide his want of confidence, but he took excessive care, and was soon safely over. Then it was my turn. Back came the pole for me; not with a steady, wheel-like motion, but with a shaky, wobbling gait, which would have made any one less confident than myself suspicious that its base was not so firmly fixed as it had been. I had a satchel over my shoulders, and whilst watching and waiting for my companions to cross, I had rapidly refreshed myself with some biscuits and the contents of a flask which were therein. Boldly I take hold of the pole; two steps, and I am in the middle of the plank; quick as lightning the pole begins to sink into those oozy depths, not perpendicularly, as if it were seeking a firmer base—that would have given me a sense of increased security—but at a slight angle from the perpendicular. But the slight angle is enough; the yielding ooze gives way before my weight and, rapidly as thought, that pole travels out across the ditch at right angles to the plank on which I am crossing. My arm goes with the pole, and in a moment my centre of gravity is disturbed, and I find my body following my arm. Quick as thought two ideas present themselves to me. If I stick to

the pole I shall travel into the slime head first; but if I let go, there is still time to let one leg in at a time, and thus to enter the water with my feet in advance of my head. My mind is made up as the thought presents itself, and in a moment I stand in the slimy ditch, my feet deep in the yielding ooze, the stagnant water up to my armpits, whilst my biscuits quietly float away on the surface, in the ever-increasing circles that my unexpected descent into the water has caused. I hang on to the plank like grim death. Yelling water demons pull my feet deeper and deeper into the filthy yielding ooze, and I struggle against their downward powers in vain. But our guide comes to the rescue. In proportion as my arms are gradually dragged from their sockets, so my feet are gradually pulled from the mud, and after a final exertion of gigantic strength, I am landed on the opposite bank, an object of misery to myself and of commiseration to my friends.

Fortunately no such mishap has occurred to-day; we are safely over, without even wetting our feet. But it is necessary to be diplomatic about the business, even after a great deal of practice. Now we can push on. Soon we reach the river side and see the old river at close quarters. It is low tide, and thrown up here and there on the shore are great masses of the seaweed which we call the bladder-wrack. It was from this that, a few years ago, almost all our iodine and carbonate of soda were obtained; but other sources of supply have long since made the production of these substances from seaweed unprofitable.

We walk along a little way, and are now some distance to the east of that part of the river which is directly opposite Cliffe; but we soon take to the marshes again, and deter-

mine to get back to our starting-place by a different route. Yonder in the distance we can see Cooling Church, and here and there, on the edge of the marshes, lonely copses may be detected. Now and again we disturb a heron, but he is not ready for home yet, nor does he fly far before settling down again. How strange it is that, gregarious as they are in their nesting-places, the "lone hern" delights in solitude when getting its food. Kingfishers, too, are pretty abundant, if we may judge by the number of sparkling gleams of blue that flash before our eyes every now and then. Here is a ruin, a shepherd's hut probably. A rough tumble-down place it is, and in far from a habitable condition; but it would appear, from the sack of chaff on the floor, that some one still uses it occasionally. The moss-grown roof is broken through, the rough stones and bricks are grass-covered. Here and there a sturdy plant of willow is pushing its way through the gaping crevices. No one lives here now, although it is occasionally useful. How? you ask. Well, it is of no use trying to get off this marsh in a fog; the only thing to do then is to wait until the fog clears; and if you should ever be caught in such a condition as this, even this ruin would be a palace. But a chaff bed. Ugh! Have you ever, dear reader, stayed at a small wayside inn where chaff beds are used? If so, you have certainly some adventure to record anent *Pulex irritans*. You have never heard of the gentleman? Think a minute of the name *irritans!* Does it not suggest at once that aberrant wingless Dipteron, the common flea, the female of which lays her whitish eggs in dirty corners, cracks in the floor, or rarely-beaten carpets, where they speedily become active, wriggling, maggoty-looking caterpillars, which in a few weeks

spin little silken cocoons, and change to the perfect insect about a fortnight later? I am sure it must, and I doubt not that some of our country experiences have been very similar to Curran's, although it is to be hoped on a slightly less extensive scale, who, when he was asked by his landlady how he had slept, replied to her:—"By heavens, madam, they were in such numbers, and seized on my carcase with such ferocity, that if they had been unanimous, and all pulled one way, they must have pulled me out of bed entirely." I remember one or two very similar experiences. Chaff beds! I shudder at the thought of them, and my

Fig. 46.—The Common Flea (*Pulex irritans*).

hands unconsciously begin to wander to various parts of my body, to commence the necessary labour. Not, however, that there is any necessary connection, social or entomological, between chaff beds and fleas unless the beds be dirty, which appears to be unfortunately only too frequently the case.

We now get over the ground pretty rapidly! Here and there, though, a three-inch plank has to be approached with circumspection, or a hurdle gate in the last stage of decay requires gentle usage in order to get safely from one side of a dyke to the other. So far, however, we are pretty dry, for we have been remarkably lucky. At last a large log by the side of a pool tempts us to rest. Before we sit down, however, we turn it over to discover what it conceals, and as

usual find it quite a home for beetles and other insects. But what is that waddling away there? Off we go, and in a moment splash into the ditch goes a toad. There's another! Not so fast, my good friend. I've got you now. We don't see many of your relatives here, although there must be a great number of you. We know, however, how fond you are of hiding away during the day, and of coming out to hunt

FIG. 47.—COMMON TOAD (*Bufo vulgaris*).

for beetles by night. You look very plump, too, much happier, in fact, than your friend the frog. Ah! here is a pool, in which we may be able to learn a great deal about your antecedents, Mr. *Bufo Vulgaris*. There is one on the mud near the edge, poking its head inquiringly out of the shallow water in which its body is immersed, whilst the whole corner here appears to be one seething mass of toad-tadpoles. A black, wriggling mass, apparently scarcely

capable of separation; but we can soon create a lively diversion. In goes the point of a stick, and away the constituent atoms of that heterogeneous mass scatter in all directions. There is a thorough-going little tadpole with a large head and tail, and two lateral gill-tufts by the side of its head, through the thin membrane of which the blood passes whilst being purified. Notice how it gulps the water into its mouth, for this little fellow breathes like a fish at present, and the water taken in at its mouth is forced into the gill-chambers, where it passes over the layers of thin membrane forming the gills, and then out of the gill-covers at the back, whilst the oxygen required by the tadpole is absorbed by the blood from the water, as it passes over the gills.

How does the blood get to the gills? you ask. Well, all the blood in the two chambers into which the heart of the tadpole is divided is impure, and when the heart contracts, the blood is driven direct to the gills for purification. Then it is carried all over the body, where it becomes impure again; then it goes back to the heart, thence to the gills, and once more over the body. Ah! there is another tadpole, rather larger than the last one, which has commenced to grow its hind legs, whilst yonder is a fellow whose arms are growing as well. Here is a remarkable fellow! He is quite like a toad, except that he has still his taddy's tail; but he will soon lose that now.

You see, then, that the toad undergoes a great deal of change when young. From an egg it becomes a tadpole, then it grows a pair of hind limbs, and later, a pair of hands; after this it loses its gill-tufts, and finally its tail, and becomes a little toad. But these outside changes are accompanied with equally important internal changes, for the

upper chamber of the heart becomes divided into two by the growth of a median partition, whilst in the upper or thoracic part of the body, two bag-like organs, composed of exceedingly fine membrane, grow. These become the lungs, and the blood which has before been pumped to the gills by the heart is now driven into the delicate membrane of the lungs instead,

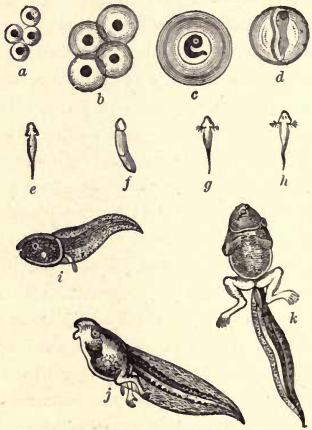


FIG. 48.—EARLY STAGES OF TOAD.

a, *b*, Eggs of toad. *c*, *d*, Embryo in egg before hatching. *e*, *f*, *g*, *h*, Newly-hatched tadpoles. *i*, *j*, *k*, Tadpoles in various stages of development.

where it is purified by absorbing some of the oxygen from the air which the hollow sacs of the lungs contain, and by passing the effete and used-up gases which it carries through the thin membrane of the lungs in the opposite direction, whence they are expelled from the body.

How do tadpoles originate? As I have said before, from eggs. That large toad with its mouth out of water is a female; at least, so one would imagine from its large size. The male is smaller, and of a much more slender build. Draw your stick along the edge of the pool! Ah! You are bringing up long double jelly-like strings on your stick. These strings are composed of the eggs of the toad, each of which has a black nucleus in the centre. They prove a considerable trouble to pull out of the water, and continually break, because they are fastened round the stems and roots of the plants growing in the pool.

You have got them out at last! Now observe the tiny black yelks. These black specks will soon enlarge and become subdivided into a number of minute cells, which absorb and live on the jelly-like mass which surrounds them, and in about three weeks the tadpoles, with their large heads and tails, will emerge; they are rather smaller and much darker than the tadpoles of the frog, although, in other respects, very similar to them. This is a very late batch of eggs. They are usually laid in April and early May. In June the toads commence to betake themselves to dry land again, and travel long distances from the pools to fields and gardens, where they revel by night, feeding on beetles, slugs, worms and caterpillars. Probably this is one of the best friends the gardener has, but he does not always appear to think so.

The mechanical processes by means of which the breathing of adult frogs and toads is effected is very remarkable. We have seen that in the tadpole state they breathe by means of gills, in the adult state by means of lungs. In mammals, the presence of a muscular diaphragm and of ribs moved by

muscles, by means of which the cavity of the chest or thorax is continually being altered in size and capacity, and alternately made larger and smaller, keeps up a regular series of inspirations and expirations, during the former of which pure air passes into the lungs and mixes with that which is already there, whilst during the latter, a part of the air in the lungs (which has been robbed of some of its oxygen by the blood in the lungs) is driven out. But in frogs and toads there are neither ribs nor diaphragm; they can only breathe, therefore, by swallowing air.

Watch that large toad by your side! It keeps its mouth closed, but continues to gulp down air, as it were. The throat is alternately contracted and enlarged; when it is enlarged the tongue is depressed, the cavity of the mouth is made larger, and air passes through the nostrils into the mouth. The mouth is still kept closed when the muscles of the throat contract, and as this contraction lessens the mouth capacity, we should naturally expect the air to be forced back through the nostrils again. But the nostrils are each provided with a valve, and although these valves allow the air freely to enter the mouth from outside, they do not allow it to pass out again. In a somewhat similar fashion the entrance to the alimentary canal is provided with a valve. When, therefore, the mouth capacity is lessened by muscular contraction, the valves at the nostrils prevent the outward passage of the air, whilst that at the entrance to the œsophagus prevents its escape into the alimentary canal. Only one channel is open to it, and down this it is accordingly driven into the lungs. The mouth is afterwards opened to let the effete air escape, but closed again to take another inspiration. There is therefore a con-

siderable amount of force in the apparently remarkable statement that if you keep the mouth of the frog or toad propped open, you may suffocate it.

How different, then, is this method of breathing from that of a mammal, and yet, again, how different from the method it adopted when it was a tadpole! Let us consider for a moment the question, "What breathing does!" From the air breathed in, oxygen is absorbed by the blood, and into the same air, before it is expired, pass used-up gases from the blood, of which carbonic acid gas is the chief. The tissues of the body are constantly requiring oxygen, with which they combine, and one of the waste products of bodily action is carbonic acid gas, which must be constantly carried off, or it will have a poisonous effect.

The methods adopted by animals for this purpose are various. In fishes the venous blood, poorly supplied with oxygen but rich in carbonic acid gas, passes through the membranous plates called gills. Water is taken into their mouths, passed over these plates, and out of the gill cavities behind. As this water, well-supplied with oxygen, passes over these thin gill membranes, the oxygen, which is dissolved in the water, passes through the thin membrane into the blood, whilst the carbonic acid gas passes in the opposite direction. This is what happens in the tadpole and other creatures that live in the water; but many of the lower forms of animal life have no proper breathing organs. In these, respiration is carried on through the surface of the body, and to a certain extent the skin of the adult toad and frog is used for this purpose. In others of the lower animals—molluscs, insects, etc.—the air enters through external holes, called spiracles, which lead into tubes and chambers, through

which the air is conveyed to various parts of the body, the blood being in close connection with or surrounding these tubes and chambers; here the oxygen is obtained directly from the air. But in the higher vertebrates (birds and mammals), specially developed organs or lungs are found. These contain hollow cavities or air-sacs, the lung substance surrounding which is filled with blood capillaries, through the thin walls of which oxygen passes from the air-sacs into the blood, and the carbonic acid gas in the opposite direction.

How does the blood convey the carbonic acid gas to the lungs, and oxygen to the tissues? There are no bubbles of gas in the blood. No! If you look at a drop of blood under a microscope, you will notice that its red colour has disappeared. The fluid is of a pale amber colour, and the red colour is restricted to a number of little cells, called blood corpuscles. These are composed of a basement membrane, which encloses a substance that combines readily with oxygen gas. In the lungs, this substance in the red corpuscles takes up a plentiful supply of oxygen gas, whilst the carbonic acid gas, which has been brought from the tissues in the ordinary plasma of the blood, is set free. Then the oxygen is carried by the corpuscles to the tissues, where it is abstracted from them. As the robbing process goes on, the lessened amount of oxygen changes the corpuscles to a dark purplish colour, and the blood which contains them is then known as venous blood. In this way the tissues in the higher animals are constantly supplied with oxygen, and thus they get rid, in part, of the deleterious gases produced by their oxidation.

The food in the blood is used up but slowly, and many

animals can do without food for a long time. Water is a greater necessity; still, many animals can do without drink for hours, and in special cases for days. But air is a matter of seconds. Such a vital process as the oxidation of the tissues brooks no delay. Oxygen the tissues must have, or death will very speedily ensue.

This wide and general consideration of breathing has carried us far away from our friend *Bufo* here. Have you ever thought of the ways in which toads differ from frogs? Toads have no teeth; frogs possess them. The tongue, too, is rather different in the two creatures; in both, the root is in front, and the tip is pointed down the throat, being thrown over and protruded with great rapidity, however, when necessary; but the tongue of the toad is rounded at the tip, whilst that of the frog is provided with two small fleshy protuberances. Both animals, however, secrete a viscid fluid, with which the tip of the tongue is coated, and to which its prey, in the shape of beetles and other insects, adheres, when the tongue is rapidly darted against it.

Like its near relations, the toad frequently changes its skin, and usually swallows the old one. This goes on during the summer months; but when—

> "The leaves are falling fast,
> And gladsome summer's days are past"—

the toad crawls into a sheltered cranny, a hole at the root of a tree, or under a log, and there sleeps away the winter in a torpid state. But when—

> "Spring is coming! The lengthening days, the cheerful light,
> Proclaim its advent near. And the frosts are keen,
> The winds do fiercely blow, and rains abundant fall"—

and, when—

"'Tis only winter's last convulsive grip to hold
What he must part with soon"—

then the toad recovers from its torpidity, and sets out to seek a pool in which to deposit its spawn. Sometimes the search is long and tedious, for the summer and autumn hunting expeditions after food frequently take it so far afield that it has to travel several miles before it reaches a pond in which to spawn.

The toad calls up memories of olden times; of its striking connection with witchcraft; of its supposed power for evil. The extent to which this belief was carried a few centuries ago was really most absurd. Even now it has not entirely vanished, for it is a settled belief in the minds of all Kentish boys who live in outlying villages that the toad "spits fire," and that being poisoned is a certain result of touching it. I have often wondered whether the "spitting fire" belief is of recent origin, and whether it has any connection with the part the frog played in the earliest discoveries of electrical action. If of older origin, probably the notion originated in the brilliancy of its eye. The belief in its poisonous propensities undoubtedly originated in the fact that the adult toad is able to excrete from the warty tubercles with which the skin is covered a most objectionable fluid, which makes dogs frequently refuse to touch them. However, in spite of these imaginary evils, the toad is unequalled as a friend to the gardener, and this peaceful and inoffensive creature undoubtedly deserves all the care he can bestow on its preservation.

But we have been resting long enough on this log. The sun is sinking rather rapidly, and we must push on, or the chaff-bed—with attendance—may claim us yet. This

thought hastens our footsteps, though first a lovely flower, then a gorgeous dragon-fly, tempts us to stay. But even the chaff-bed is forgotten by the side of a thick bed of reeds, as we commence investigating a number of them which are affected by the larva of one of the Wainscot moths. Almost every other reed has the central leaf dead and yellow, and as we pull these, one after another, from their watery home and open them, the dirty white caterpillar of *Nonagria geminipuncta* comes tumbling out. *Geminipuncta* means "twin-spot," and the moth is so-called because it usually has two white spots on each of its fore-wings. And there, low down on this reed, a little round spot shows where a caterpillar has left a thin layer on the outside skin of the reed, and formed a cosy little cocoon inside, in which it has changed to a bright brown chrysalis. It knows very well that it cannot get out when it changes to a moth, because, having no jaws, it cannot eat its way through the thick reed stem, and so, before it loses its jaws, before it pupates, it gnaws a hole, only leaving the finest film of outside skin; then, when the moth emerges, it presses its head against this fragile spot, and a fluid coming from two little glands on the top of the head softens the skin, and the moth readily escapes; so that the thin film is easily overcome, although the moth has no jaws.

Dusk is rapidly falling; other pale Wainscot moths are already on the wing. The Ghost moth, with pendulous motion and delightful scent, is wooing his mate. We are nearly at one of those copses. Hist! We are in truth in luck's way! I don't know how many years it is since I last saw the otter at large. Oh, yes! it saw us before we observed it, and there it goes creeping stealthily to the water.

Now it is passing the willow tree yonder, and see, you can follow it again as it glides noiselessly into the stream, and swims away, eel-like, below the surface of the water. It is quite a rare animal in Kent now, although years ago it was plentiful rather than otherwise. Its voracity, however, has been its ruin. It catches fish with the greatest skill, its webbed feet, long powerful tail and well-developed muscles rendering it very agile in the water. If, however, it killed only what it required for food little harm would be done; instead of this, it kills all it can catch, and many a fine fish may be found on the banks of rivers and streams haunted by otters which has been scarcely tasted before being cast aside. The rat and the crow follow in the otter's wake, whilst even the stately heron does not object to claim its tithe of the rejected of the chase.

The otter lives in a burrow near the bank of a river or stream, generally where there is a moderate amount of cover. A thick, almost impenetrable copse, or a wood, into which it can retreat in time of danger, is much preferred. It is a powerful, heavy animal, some three or four feet in length, with an exceedingly thick skin, dark brown hair, and grey face. In the early part of the year the female otter usually has three or four young ones, and these are generally born before April has passed. In her burrow the young ones are brought up, and the mother will fiercely defend them, and at such a time generally comes off victorious over any dog that may attack her.

Well, the otter is gone now, and here, under this copse, we will slowly return. We need not hurry, for we are quite off the marshes, although the ditches come up to the coppice edge.

As we stand still a stag-beetle comes booming along. These large beetles occur very abundantly in our southern counties, flying heavily along just before and after dusk. Knock it down with your hand and examine it. You can

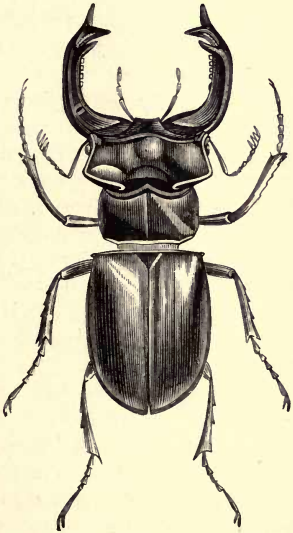


FIG. 49.—THE STAG BEETLE (*Lucanus cervus*), MALE.

readily understand how it obtained its common name, and why the learned call it *Lucanus cervus*. Observe the two large horn-like processes sticking from the front of its head. These are really its mandibles or upper jaws, and are found only in the males, the females having no special

development in this direction. In addition to these strong jaws, notice how powerfully made is its thorax, and how hard is its black shiny outside skin. What large membranous wings it has, and how insistingly it withdraws them under the strongly made wing-cases, or elytra.

A word or two about its earlier history. The female lays her eggs in the crevices of oak, willow, and other trees common in our woods, and when the caterpillars hatch therefrom, they bore into the solid wood of the tree on which the eggs were laid. After a little time they change their skin in the tunnel thus formed, the caterpillars get larger, and make the tunnel proportionately bigger. How much damage only one caterpillar may do it is impossible to say, but it keeps at this destructive work for at least three or four years before it is full-grown. It is then a large whitish grub, differing very greatly from that of the butterfly or moth; for, although it has the six ordinary legs on the thoracic segments, it is without fleshy protuberances or prolegs on the abdominal segments.

It is said that in some instances the grub takes six years to come to maturity, although four is the usual period occupied. When full-fed the caterpillar forms a cocoon of the chips and pieces of wood left loose in its burrow, and in this it changes to a chrysalis. This is not active like that of a dragon-fly, but quiescent like that of a moth.

The Romans considered one of our largest wood-boring caterpillars a great gastronomic delicacy, and used it for edible purposes under the name of *Cossus*. The honour of being the particular dainty in question is disputed by three caterpillars—that of the Stag-beetle, which we have just been talking about; that of the Goat-moth, which

still retains the Roman name, being called *Cossus ligniperda* at the present time; and that of *Cerambyx heros*. Which it was we will not attempt to decide. To our modern taste all three perhaps appear equally disgusting.

Are there any other insects whose caterpillars do damage in this way? Yes, many. None in Britain are so large as these, but many are even more destructive, owing to their greater numbers. All the Clear-wing moths do damage to trees when in their larval stages. One species bores into the

Fig. 50.—The Wood Leopard Moth (*Zeuzera pyrina*), female.

slender stems of our currant bushes, another into the birch, while others attack the apple, pear, alder, oak, willow, poplar, and several other trees. Then the caterpillar of the Wood Leopard moth, whose almost transparent wings are covered with bright metallic, greenish-black dots, does immense damage to trees in our London parks. Almost all the branches that come tumbling about our ears during a high wind are snapped, owing to the damage done by this dreadful scourge, whilst it has been estimated that one

female alone lays above a thousand of her minute salmon-coloured eggs. Well, we must not pursue this matter farther now, or we shall not leave the marshes to-night.

How delightful is everything about us this early summer night; the sweet scent of the honeysuckle diffused on the almost still air; the gentle rustling of the reeds, as they sway against each other under the gentle breaths of air that ever and anon break the stillness; the loud buzzing of the cock-chafer; the cheerful light of the glow-worm; above all, the delicious melody of birds. Just before the glow-worm puts forth her lamp, or the night-moths begin to fly; just before the night-jar snaps his wings, or the bat commences its evening flight, there is a delicious outburst of woodland song. "Good-night" it sings in soft and gentle accents, and then a sweet strain of clearly defined and charming notes from the delightful sedge-warbler falls in delicate cadence on the ear from the reed-bed yonder; again all is still save the gentle murmuring of the whitethroat, and the sweet good-night of the blackcap. As you listen for the sedge-warbler again, clear and distinct from the oak-bough above you come floods of delicious song. Up, up, the song ascends, the singer knowing that he is now without compeer; then it falls in a number of trilling tones, until in silence one wonders when the song ceased. Has it ceased, or is it still ringing in our ears? No; the song we hear now is the distant melody of the grasshopper warbler, which appears to live in amity with its relative in the reed-bed yonder. Whilst meditating on the variability of its note, Philomel again raises his voice to welcome the first glimpse of the rising moon. The white-throat and the blackcap have ceased their warbling; they have sung their last good-night, and left the two songsters

in the reeds and the nightingale in the tree, the sole performers to the night which has now really come.

And here, dear reader, we will say good-night, under the scented hawthorn bush, with the nightingale still pouring forth its song, and the night-jar's weird cry still ringing in our ears, happy if we have learned during our walks together that—

> "No bud is opened in the spring,
> No banner of a leaf unfurled,
> That does not wake, in thy response,
> Some hidden meanings of the world;"

thankful if we have learned to agree with the poet that—

> "Happy is he who lives to understand,
> Not human nature only, but explores
> All natures to the end that he may find
> The law that governs each; and where begins
> The union, the partition where, that makes
> Kind and degree among all visible beings;
> The constitutions, powers and faculties,
> Which they inherit—cannot step beyond—
> And cannot fall beneath; that do assign
> To every class its station and its office,
> Through all the mighty commonwealth of things,
> Up from the creeping plant to sovereign man.
> Such converse, if directed by a meek,
> Sincere, and humble spirit, teaches love:
> For knowledge is delight; and such delight
> Breeds love; yet suited as it rather is
> To thought and to the climbing intellect,
> It teaches less to love than to adore;
> If that be not, indeed, the highest love!"

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